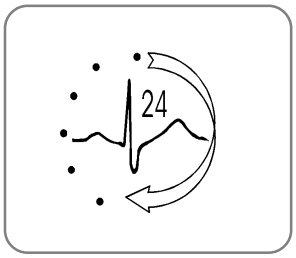
MT-100/MT-200

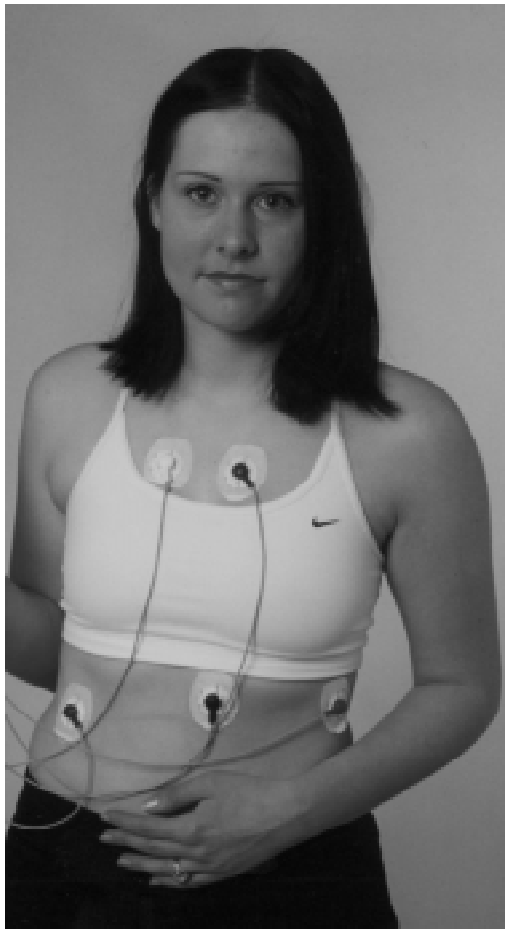
Holter Data Management and Analysis System



Section 1 - Taking a 24 Hour Holter Recording

Commencing a 24 hour Holter Recording

Note: We strongly recommend that the ECG signal is checked before commencing every Holter recording. However, the MT-100 Holter recorder can be started without first checking the ECG signal if required - see Annex A.

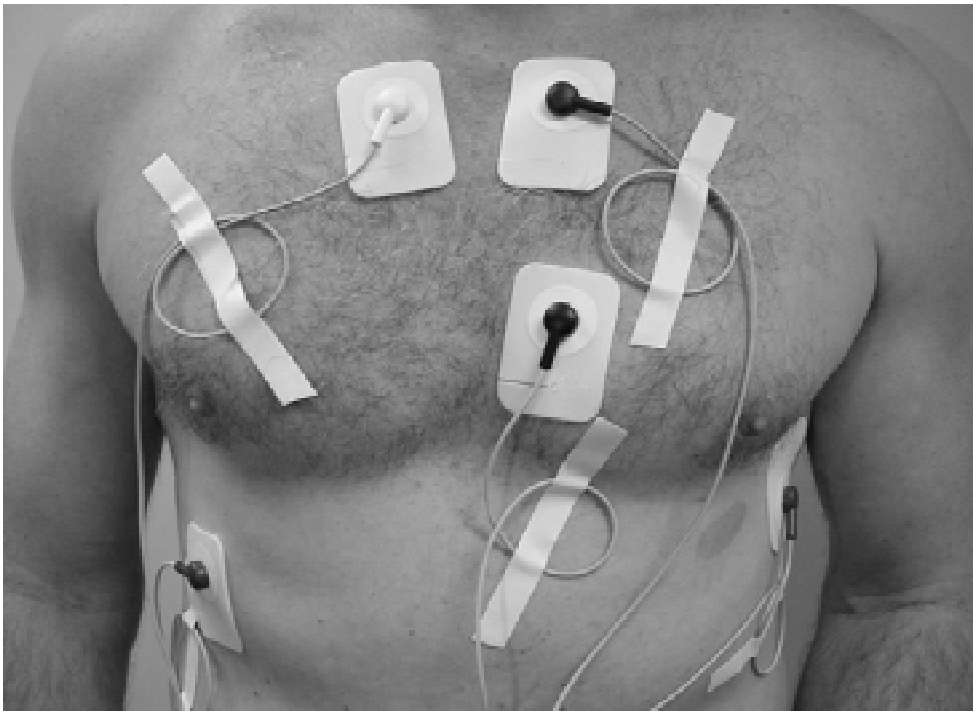


To check the signal from the patient and commence a Holter recording proceed as follows:

- **INSERT FRESH BATTERIES IN THE MT-100.**

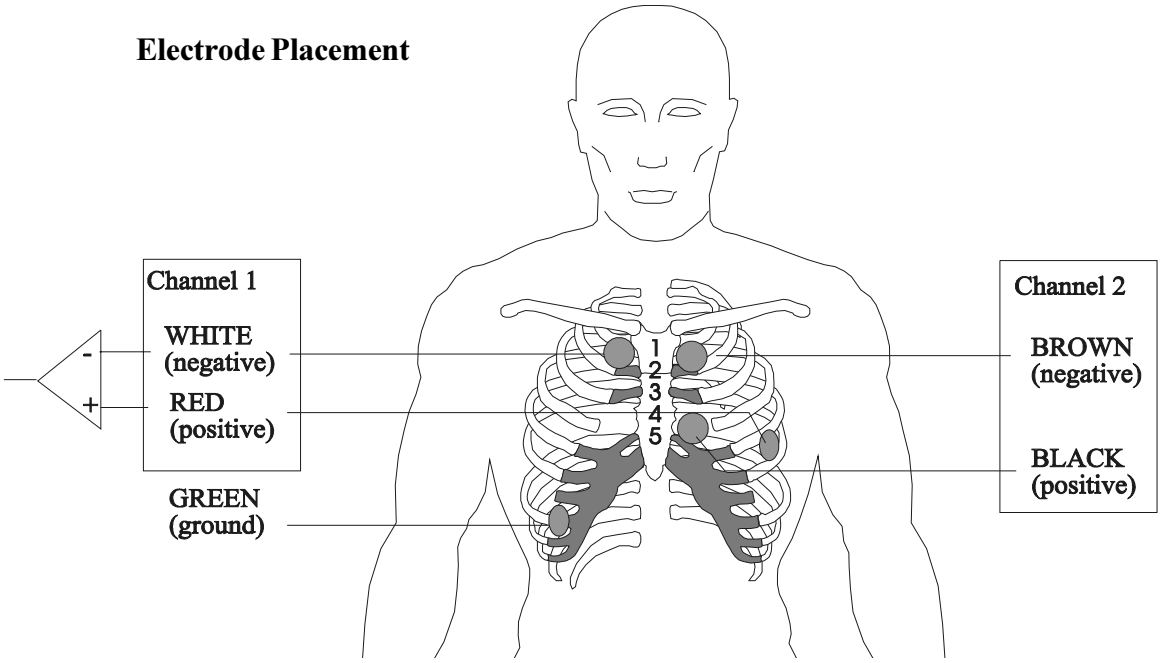
  Gently apply downward pressure on the battery cover top and open cover - insert 2 AA 1.5V batteries - ensure correct orientation of the batteries. Close battery cover and 'click' to secure.

- **Prepare patient (Electrode placement shown). Form a stress loop in every lead for electrode security and patient comfort. Give enough slack between stress loop and electrode to allow patient to move without affecting electrode positioning. Secure leads and electrodes with tape or plaster. Instruct patient to place hands above head, ensure that the electrodes remain positioned and that no undue stress is placed on the leads and electrode positions.**



Commencing a 24 hour Holter Recording

Electrode Placement



Holter ECGs use a bipolar lead system (one positive and one negative lead) for each channel. Channel 1 approximates to modified lead V_5 : Channel 2 approximates to modified lead V_2.

Channel 1	Place the WHITE negative electrode under the clavicle on the right sternal margin.
	Place the RED positive electrode in the fifth left intercostal space on the anterior axillary line (position approximately equates to V_5).
Channel 2	Place the BROWN negative electrode under the clavicle to the left sternal margin.
	Place the BLACK positive electrode in the fourth left intercostal space near the sternum (position approximately equates to V_2).
Ground	The GREEN ground electrode should be centered over a rib on the right side of the body. Exact placement is not critical and does not affect the recording

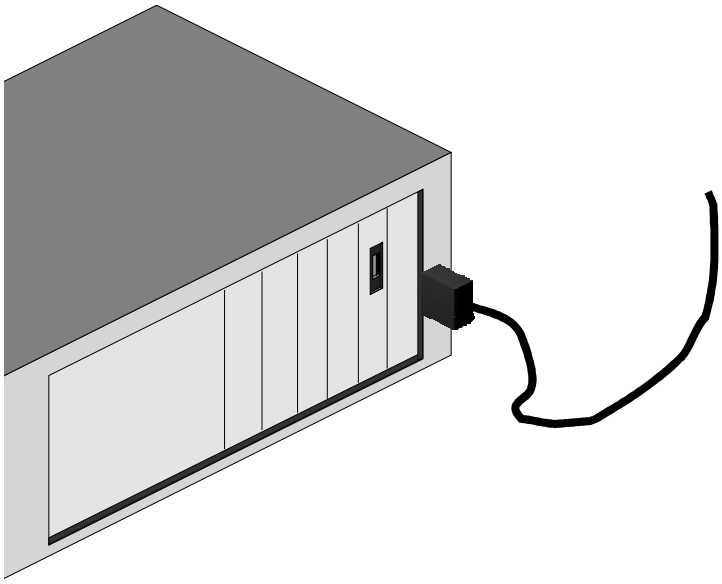
- *The above electrode placement is suggested. Other electrode configurations are possible.*
- *Ensure that the QRS complex is bigger than the T wave.*
- *To avoid artifacts in women patients the red and black electrodes can be placed lower if necessary*

Commencing a 24 hour Holter Recording

- **Remove the Protective cover on the Opto (PC) connector on the MT-100 Holter unit**
- **Remove the protective cover on the opto connector on the back of the PC**
- **Connect the MT-100 Holter recorder to the opto connector on the back of the PC with the opto cable assembly**

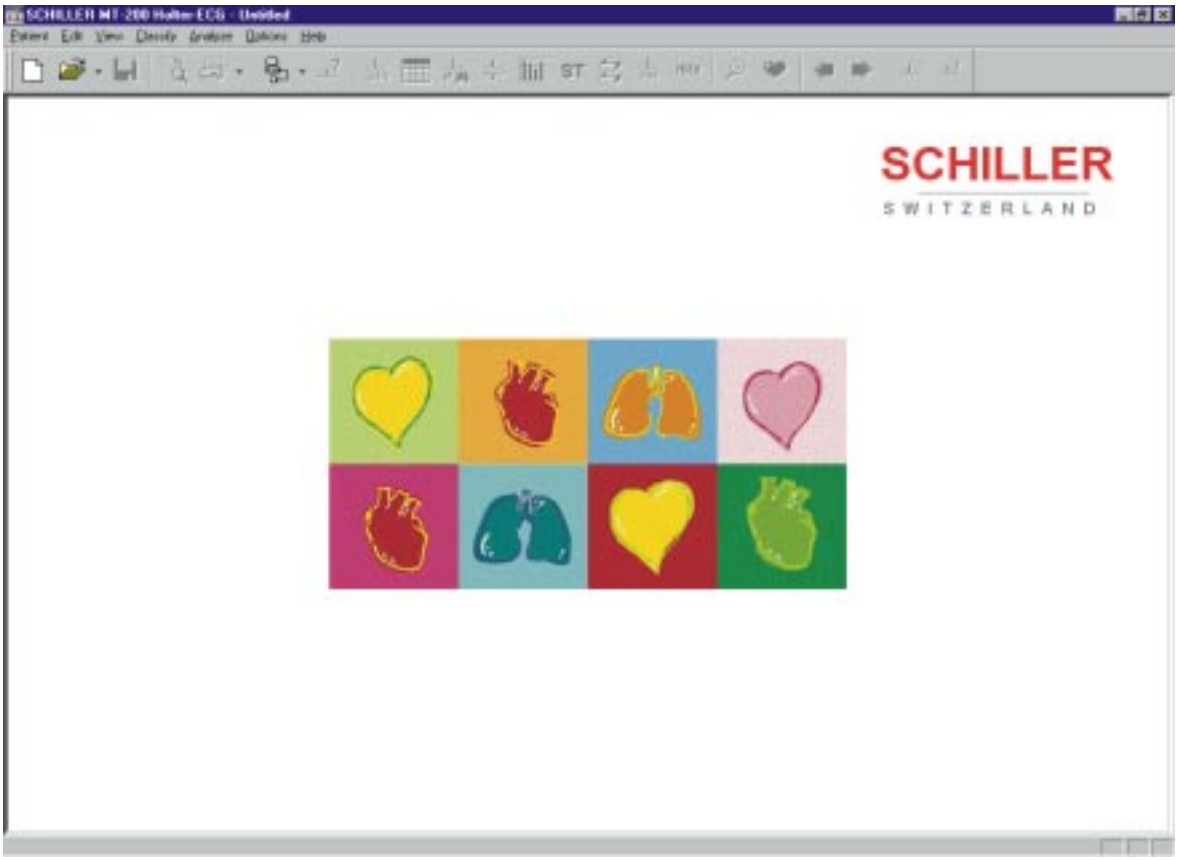
The special opto cable must be handled with care. To ensure reliable service from the opto cable observe the following points:

- Take care not to crush the cable with a heavy object.
- Take care not to run over the cable with, for example a chair.
- Do not tread on the cable.
- When not in use, coil the cable in a loop - **DO NOT BEND.**

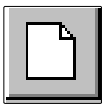


- **Open the MT-200 program on the desktop (double click with the mouse) or the Start menu>Schiller>MT-200. The welcome page is displayed:**

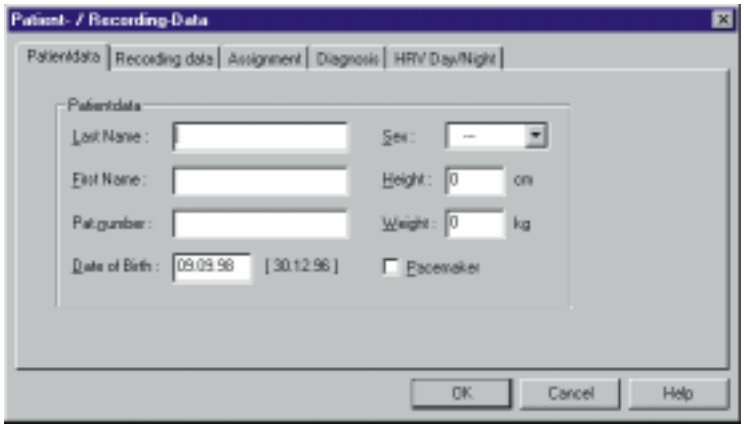
Commencing a 24 hour Holter Recording



° **With the mouse click on the `New Recording` icon on the extreme left of the function icon bar**



The patient data screen is displayed:



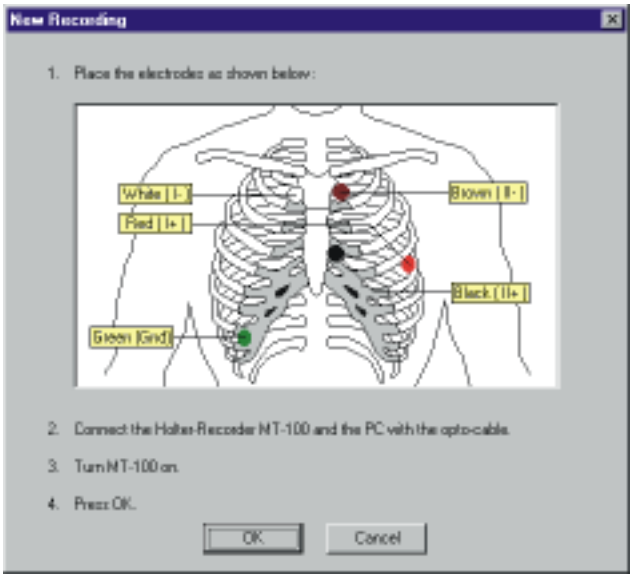
Commencing a 24 hour Holter Recording

° **Enter patient data.**

- **Select the next data entry field with the mouse OR**
- **Select the next data entry field with the TAB key on your computer**

If the patient is known to have a pacemaker fitted check the pacemaker box. If this box is not ticked pacemaker spikes will not be detected or displayed.*

° **When the details of the patient have been entered press the ENTER key on your computer or click with the mouse on OK. The following is displayed:**



° **Switch the MT-100 on by pressing the event button.**

° **Click OK (in the above screen). The patients ECG is displayed.**

Commencing a 24 hour Holter Recording

Note: The data displayed or entered on the other pages of patient data - selected by clicking on the tabs at the top of this screen (Recording data, Assignment and Diagnosis) - are available only after the recording has been made.

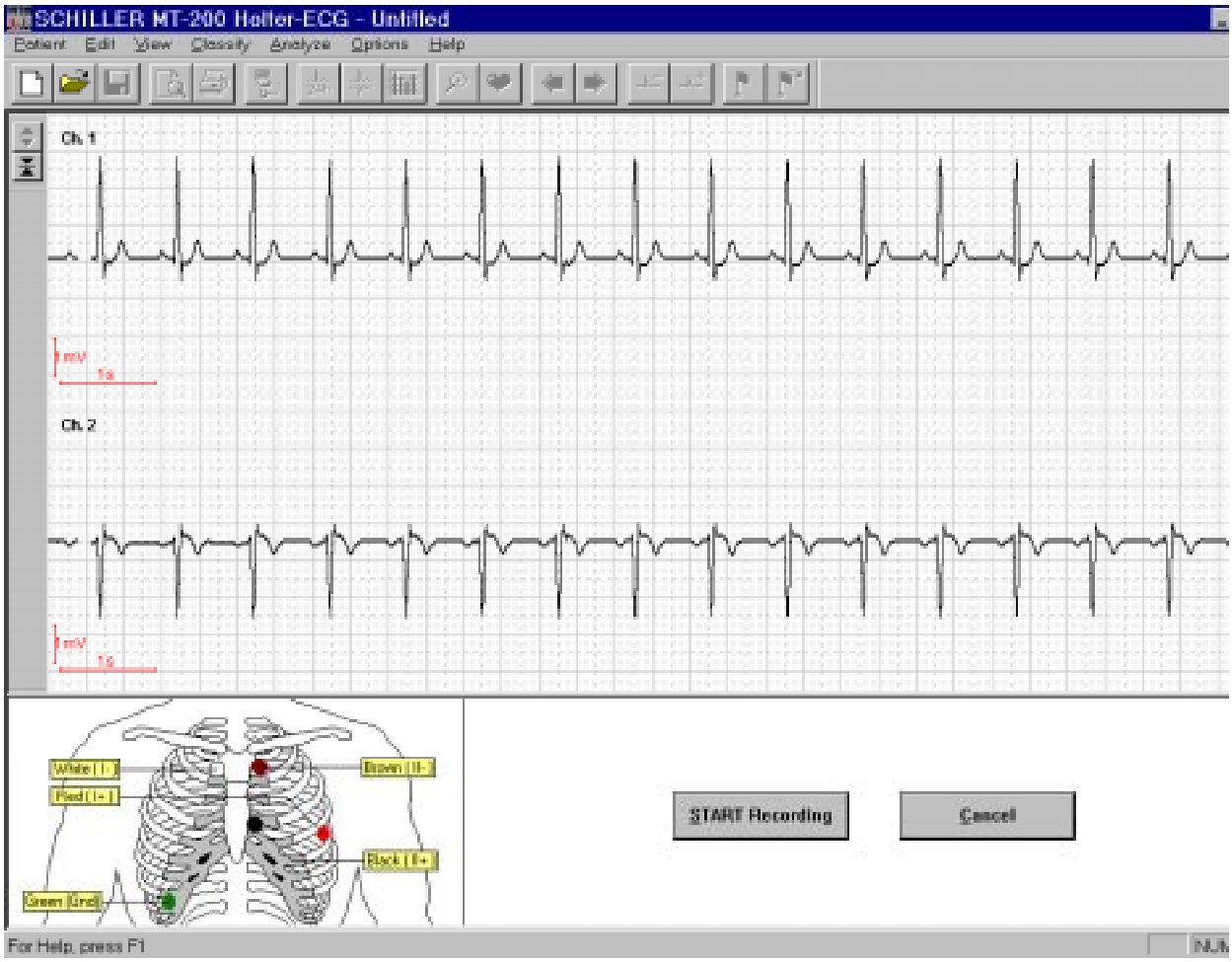
* For pacemaker signals to be detected by the MT-200, the pacemaker detection function must be switched on at the MT-100 before starting data acquisition - this is done by checking the pacemaker box in the patient data screen.

Pacemaker signals are detected in the long-term ECG recording by the MT-100 when the slopes and amplitudes of the signal exceeds preset limits and when pacemaker detection is enabled. The MT-200 program cannot determine pacemaker spikes itself and it is not possible to detect pacemaker signals by later analyzing the recording in the program if the pacemaker detection function was not enabled during the original recording. This is because the MT-200 uses a sampling rate of 500Hz (i.e. a digitalization interval of 2ms) and the short duration of the pacemaker signals (less than 1ms), makes complete digital processing of the detected pacemaker signals impossible. Therefore, analogue processing of the ECG signals is applied by the MT-100 for pacemaker detection.

Pacemaker detection is confined to the first channel of the MT-100 and is therefore optimal when the amplitude of the pacemaker signal for the first ECG channel is greater than that for the second channel. In some instances this is not the case, and it is recommended that the real-time ECG traces are viewed on the screen before starting the long-term recording. Pacemaker detection is automatically enabled on the real time display. The pacemaker signals however, are not always detected. If this is the case and the amplitude of the pulse is greater in the second channel, simply exchange the electrodes of channels 1 and 2. Before starting the long-term ECG recording the pacemaker detection on the MT-200 must be enabled.

Pacemaker signals are marked in the MT-200 program by vertical lines in the ECG after evaluation of the recording. Note that these lines are correctly positioned in relation to time but are *not* proportional in either amplitude (voltage), or duration of the pacemaker pulse, nor do they indicate the polarity. The pacemaker representation is always positive, but the actual pacemaker spike may be positive or negative.

Commencing a 24 hour Holter Recording



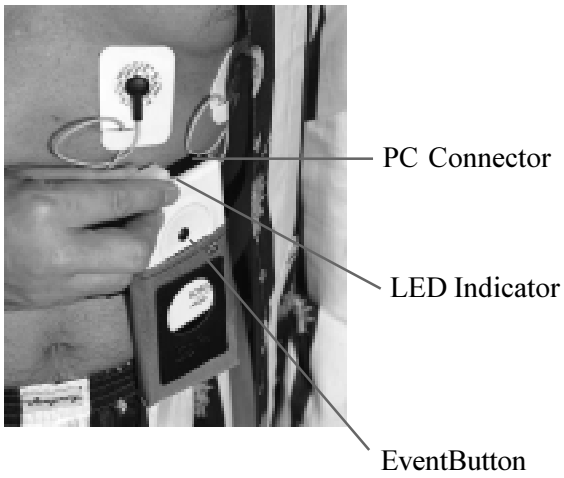
- **Check the signal - reapply electrodes if necessary.**
- **Click START RECORDING to commence the recording.**

  Recording has now commenced and the MT-100 will continue to record the patients ECG for 24 hours or until terminated. Recording is indicated on the MT-100 by the LED indicator flashing every 2.5 seconds (see MT-100 User Leaflet).

- **Remove the connector from the Holter Recorder MT-100 and replace the protective cover over the connector.**
- **Remove the connector from the PC and replace the protective cover on the connector.**

Commencing a 24 hour Holter Recording

- **Instruct the patient on use. The following should be mentioned:**
  - **Logging the time of activities and symptoms in the patient diary.**
  - **Instruct the patient to press the EVENT button at any time during the recording to register and event. Event acknowledgment is given by the LED flickering continuously for approximately 7.5 seconds.**



  - **The MT-100 is not waterproof - the patient should be advised not to take a bath or shower.**

MT-100 Indications During Use

The following table gives the MT-100 LED indications during use.

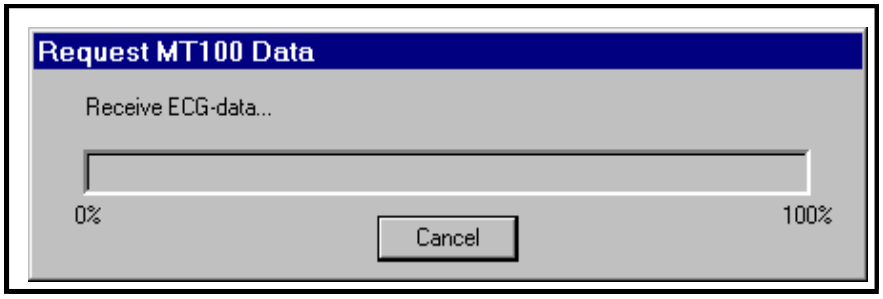
MT-100 Functions	LED Indication
Unit active	LED lit - momentarily flashes off every 2.5 seconds
Unit Recording	LED off - momentarily flashes on every 2.5 seconds
Event Recorded (during recording)	Blinks continuously for 7.5 seconds after an event is recorded (event button pressed during recording).
Monitor mode - ECG displayed on PC	Flashes off and on (ON 1s, OFF 1/4s)
Downloading recording to PC	Flashes on and off (ON 1/4s, OFF 1s)

At the End of a 24 Hour Holter Recording

To download an ECG recording from the MT-100 Holter recorder to the MT-200 program proceed as follows:

1. **Remove the electrodes from the patient.**
2. **If the MT-100 Holter unit is still recording (LED blinking every 2.5 seconds), stop the recording as follows: press the event key and hold pressed until the LED comes on - then release the event key. The LED is switched off.**
3. **Remove the protective cover from the opto connector (see MT-100 operating leaflet) and remove the protective cover on the opto connector on the back of the PC.**
4. **With the opto cable link connect the Holter to the opto connector on the back of the PC.**
5. **Switch the MT-100 Holter recorder on by pressing the Event button. The LED is lit - and blinks every 2.5 seconds).**
6. **Select the data transfer icon with the mouse.**

The following is displayed showing that the recording is being transferred

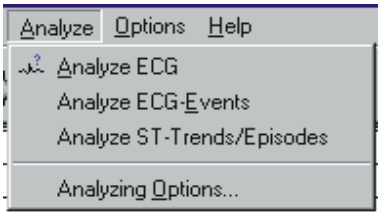


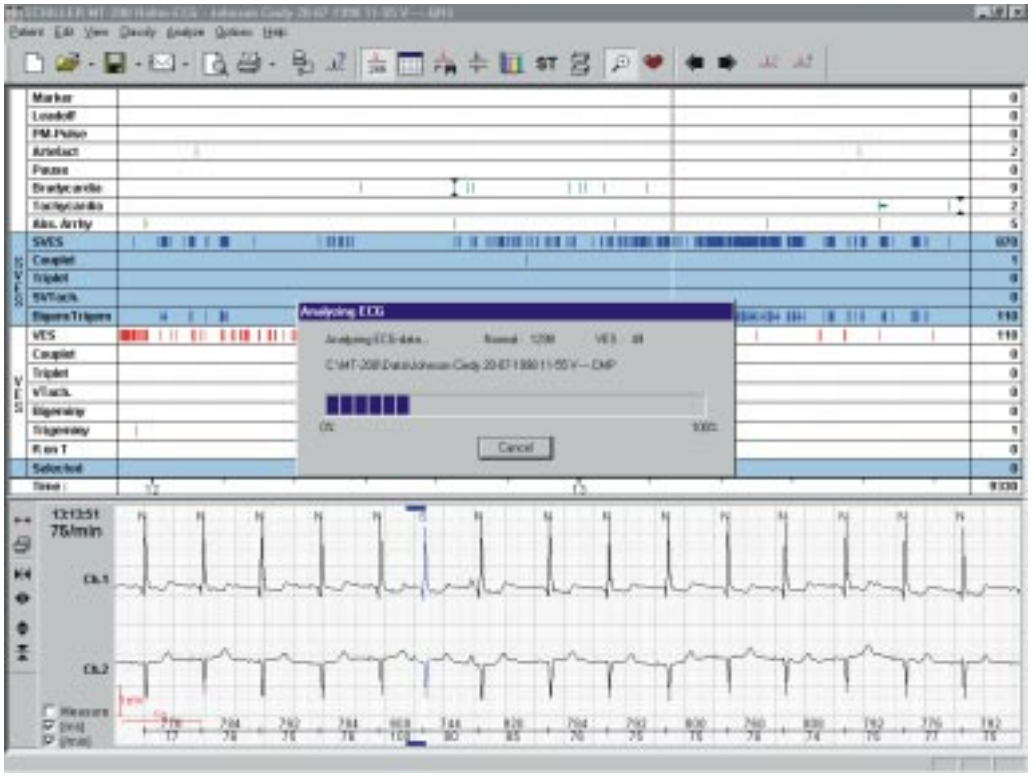
Data transfer is automatic and takes approximately 90 seconds for a complete 24 hour recording. On completion a message is displayed to indicate that data transfer has been successful. The Event screen is displayed:

At the End of a 24 Hour Holter Recording

7. Analyze the recording - Select the analyze recording icon with the mouse

Or select `Analyze ECG` in the analyze menu.

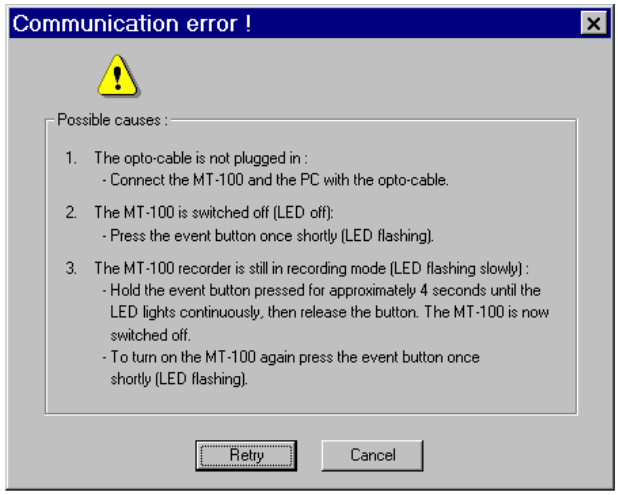




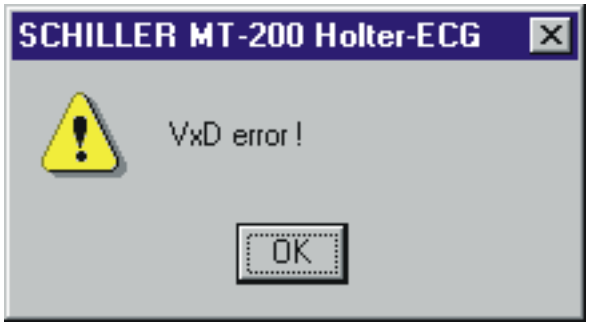
Analysis of a complete 24 hour recording may take a few minutes. A counter giving the number of analyzed beats is displayed at the top of the analyzes screen with a progress indication. The ST data is analyzed after the Event analysis.

Problems

If one of the following message appears either before starting a recording or when attempting to transfer a recording from the MT-100 to the PC, the most probable cause is:


Communication error !
Possible causes :
1. The opto-cable is not plugged in :
- Connect the MT-100 and the PC with the opto-cable.
2. The MT-100 is switched off (LED off):
- Press the event button once shortly (LED flashing).
3. The MT-100 recorder is still in recording mode (LED flashing slowly) :
- Hold the event button pressed for approximately 4 seconds until the LED lights continuously, then release the button. The MT-100 is now switched off.
- To turn on the MT-100 again press the event button once shortly (LED flashing).
Retry
Cancel

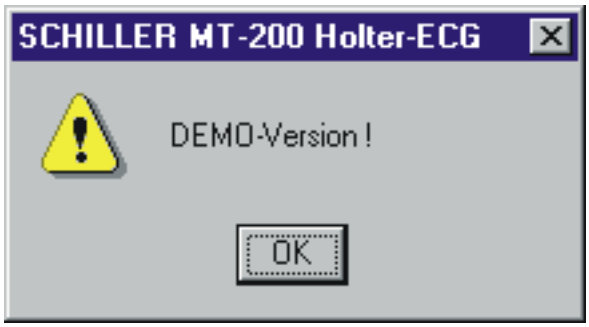
- the opto cable assembly is not inserted correctly in either the MT-100 or the computer
- the MT-100 is not switched on.
- the AT card has not been installed correctly
- the address set in the program and the AT card are incompatible.
- Ensure that the MT-100 is switched on (LED indicator on the MT-100 lit)
- Check that the opto cable is securely connected to both the PC and the MT-100
- Ensure that fresh batteries are correctly positioned in the MT-100 (when commencing a recording.)
- Try again - if the problem persists contact your nearest Welch Allyn agent.



If using the program for the first time:

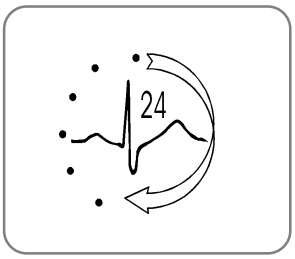
- Check that the address set on the AT board and in the program are the same - see Section 5

If the following message appears it indicates that the hardlock key is not present or incorrectly inserted, or if there is no general license.



MT-100/MT-200

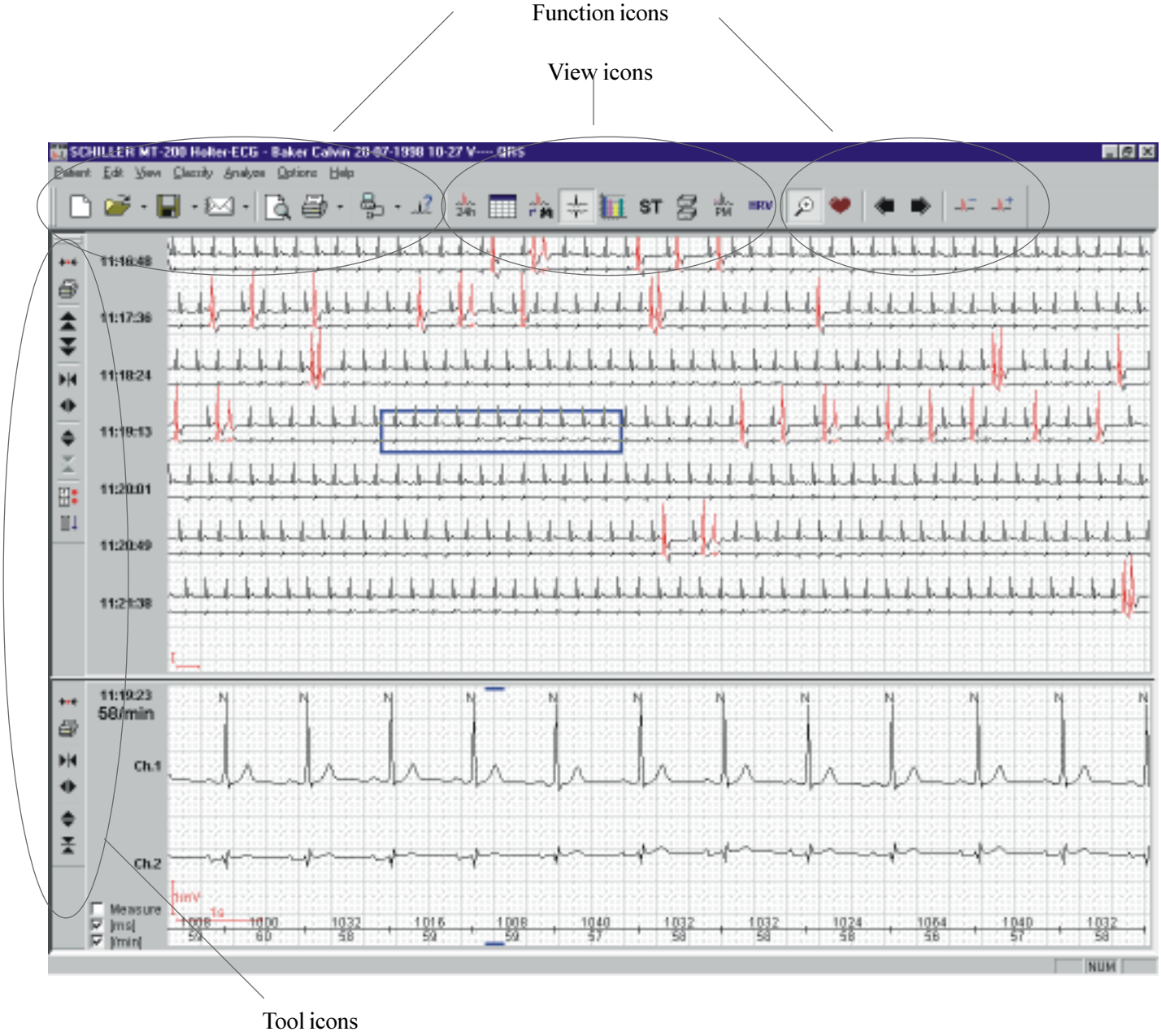
Holter Data Management and Analysis System



Section 2 - Viewing a Recording

Introduction

The MT-200 program gives different views. Each view gives various data and analysis information of the recording. Each view is selected by clicking on a view icon situated at the top of the screen. With the view icons are additional function icons which provide easy and quick access to common functions; all of these icons are displayed in all views at all times. In the ECG (Rhythm) and zoom views, additional function icons - to change size of the trace and/or the time segment of the recording - are given to the left of screen.



All icons are selected in the same way by positioning the cursor on the icon and clicking with the (left) mouse button.

When an icon is dimmed it means that this function is not available for the currently displayed screen. For example, when in ST view the zoom function is not available and the zoom icon is dim i.e. this function is not possible. The patient name is always displayed at the top of the page when an ECG recording is displayed.

Introduction

The function and view icons, are only active (can be selected) when a patient recording is displayed. When an icon function cannot be selected, the icon is dimmed.

View Icons

Event View This gives an overview of all events for the entire 24 hour period. Use this view to quickly identify and select a specific time segment for display.

Analysis Summary View This provides a tabular overview of all important measurements taken over the entire recording

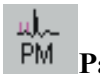
Event Samples View This allows three event samples from every category of event, to be selected and displayed. This view can also be used to select the user selected event samples for printing.

Rhythm View This zooms in on a specific time segment of ECG for closer analysis (scrolling).

Event Chart This provides a graphical overview of all events for the entire 24 hour recording.

ST Trend View This option provides a graphical overview of the ST trend with tabular measurements for ST episodes.

Template View This optional feature provides a graphical overview of the different types of averaged QRS waveforms with classification, detected over the entire recording.



Pacemaker View This option provides a graphical overview of QRS templates measured in relation to the pacemaker pulse, over the entire recording.

Heart Rate Variability This optional feature provides a graphical and toolbar overview of the heart rate variability over the entire recording.

Note: All options can be enabled with a code (for the hard-lock key) supplied from Welch Allyn.

The lower section of the Event view and the Rhythm view additionally displays either a specific zoom segment of the ECG, or the heart rate trend over the complete recording.

Zoom View This gives a zoom view of a selected segment of the ECG. In this view it is also possible to edit (reclassify) specific QRS complexes. See `Reclassifying / Editing a QRS Complex` later in this section.

HR Trend This displays the heart rate trend over the entire recording.

Function Icons

The recording function icons are as follows:

Save Recording

Save current recording

E-Mail

Send currently displayed recording by E-mail

Print Preview

Display print page layout (pages that will be printed when the printer is selected

Scroll Back Icon

Scroll backward (in time) of the zoom ECG currently displayed.

Scroll Forward Icon

Scroll forwards (in time) of the zoom ECG currently displayed

Scroll Event (back) Icon

Go to previous event

Scroll Event (Forward) Icon

Go to next event

Introduction

Tool Icons

The ECG toolbar is displayed in Rhythm and Zoom views on the left hand side. Use the ECG tool bar to:

- increase/decrease the size (amplitude) of the ECG
- increase / decrease the speed of the ECG
- move up / down a page (ECG view)
- move up / down an ECG line (ECG view)
- immediately print a selected half hour segment of the recording (ECG view)
- select a zoom section of the recording for printing (zoom view)

The page up/down and line up/down are not applicable and are not displayed in the zoom view

Center

In the ECG View - center the selected (highlighted) ECG section in the middle of the screen

In the Zoom View - position the selected QRS complex (cursor above and below QRS complex) slightly to the left of center in the zoom screen

Print

In the ECG View - immediately prints 1/2 hour of the selected (highlighted) ECG. A rhythm section of the recording is printed giving 1/4 hour before, and 1/4 after the selected section.

In the Zoom View - this sets the selected pointer (Event view) to print the zoom section selection when requested. `User Selected` box checked prior to printing.

Page Up

Move to the previous page. Each page displays between approximately 1 and 24 minutes of recording dependent on the speed selected

Page Down

Move to next page

Line Up

Shift the display up one line

Line Down

Shift the display down one line

Decrease Speed

Decrease scale of ECG (ECG closer)

Increase Speed

Increase scale of ECG (ECG spacing wider)

Increase Amplitude

ECG bigger

Decrease Amplitude

ECG smaller

Select Channel

Select channel 1, channel 2 or both channels (for display)

Auto Scroll Down

Automatically scroll down through the recording

Accessing and Opening Files

Use the open file icon to

- Open a file
- Review stored files
- Show all Exported /not exported or validated / not validated recordings

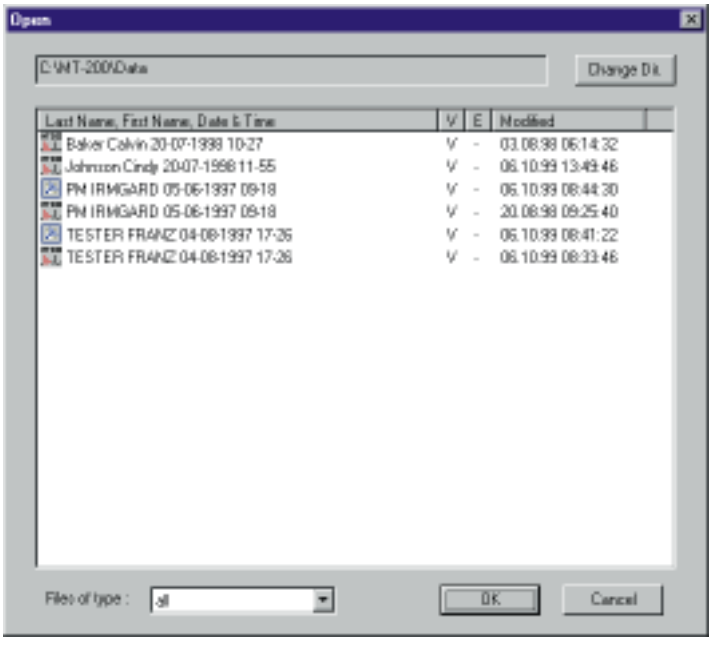
Opening a file

Click on the file icon **in the main function icon bar to display all recordings**

Click on the arrow by the side of the icon to display the last 4 saved recordings

The files (and folders) in the folder stated at the top of the display are listed:

The last folder to have been selected is displayed at the top of the screen, and the files contained in that folder are displayed. Move the mouse to select the required record that you require.



- The `V` and the `E` columns indicate if the recording has been validated or exported

Accessing and Opening Files

Note: Only MT-200 files can be opened by the MT-200 program.

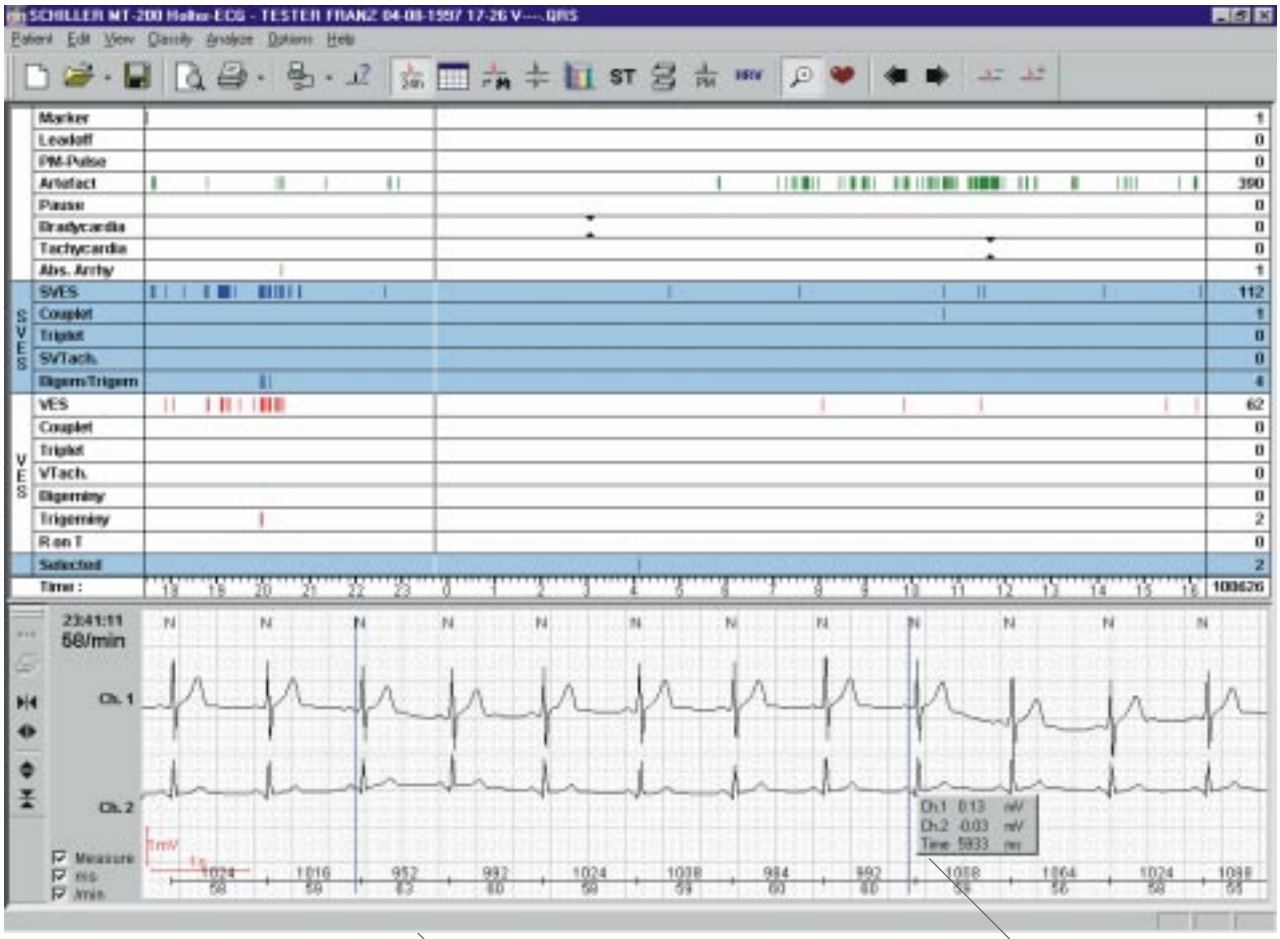
2. Highlight the file that you wish to open and then `double click` with the mouse

If a file you require is not displayed:

- **check the `files of type box`. In this box you can specify specific file types for display. If in doubt we recommend that the default is left at `all files`.**
- **check the `Change Dir` box to select another folder - the file you require may be in another folder**

Event and Zoom View

Click on the Event View icon



Event and Zoom View

When a file is opened the EVENT view is given. This screen displays all the events in the entire recording. The time scale of the recording is displayed below the events.

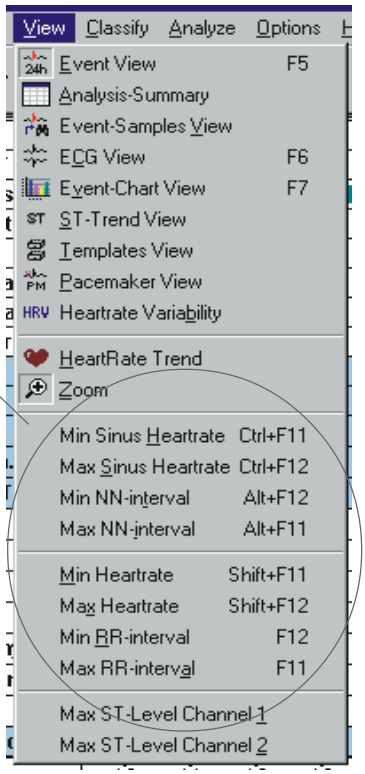
Click anywhere in the event table and a vertical line is displayed. A zoom view (or HR trend) of the selected section of the recording is displayed in the bottom section. Move the cursor anywhere in the event table and click with the mouse button. The vertical line is repositioned to the time indicated by the cursor and the time segment of the zoom ECG view (or HR trend) corresponds.

The numbers at the right of the event table give the total number of specific events detected in the entire recording.

Lowest / Highest Heart Rate; Minimum / Maximum RR Interval

The black up and down pointing arrows positioned in the bradycardia and tachycardia events, indicate the lowest and highest heart rates (with reference to time) measured in the complete recording.

To display the zoom view of the highest/lowest heart rate select from Max/ Min heart rate or sinus heartrate from the View menu:



Zoom View

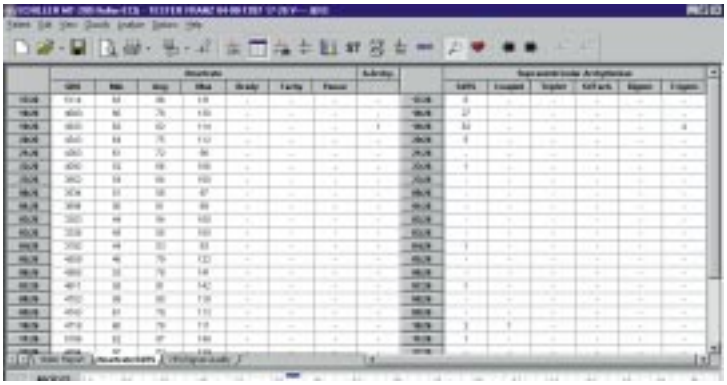
A measurement box is displayed in the zoom view when the measurement display box in the bottom left of the zoom screen, is checked. This give the amplitude and time difference between the two vertical blue lines. The two blue lines can be positioned anywhere on the zoom view by moving with the cursor - the measurement values instantly change.

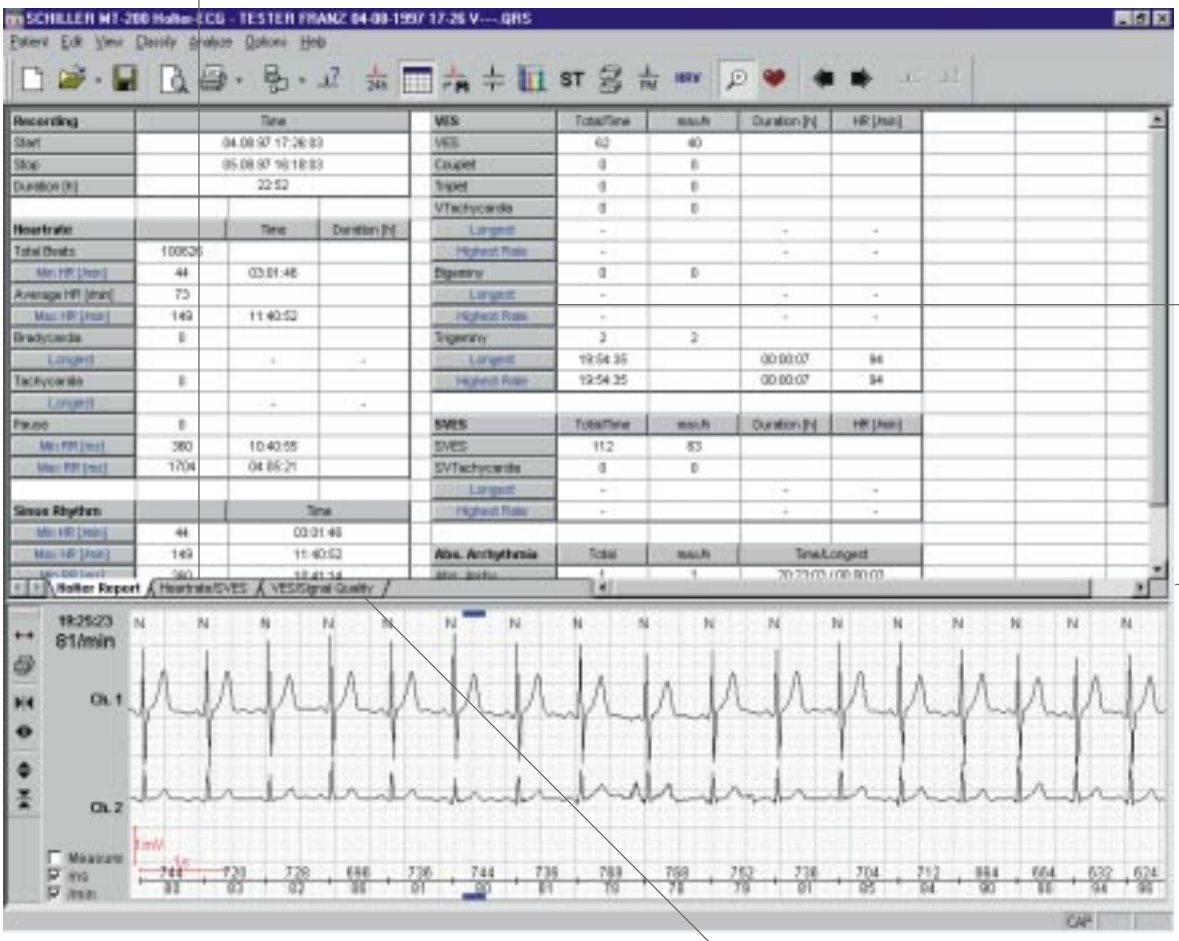
The two lower settings situated in the bottom left of the zoom screen display the measured time and heart rate when checked and indicate:

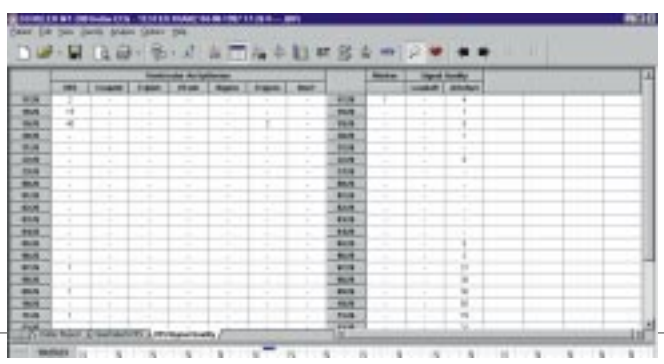
- the time in milliseconds between respective heart beats
- the heart rate calculated beat to beat

Analysis Summary

Click on the Analysis Summary icon







Analysis Summary

An analysis summary of all important data over the entire Holter recording, is given on three pages.

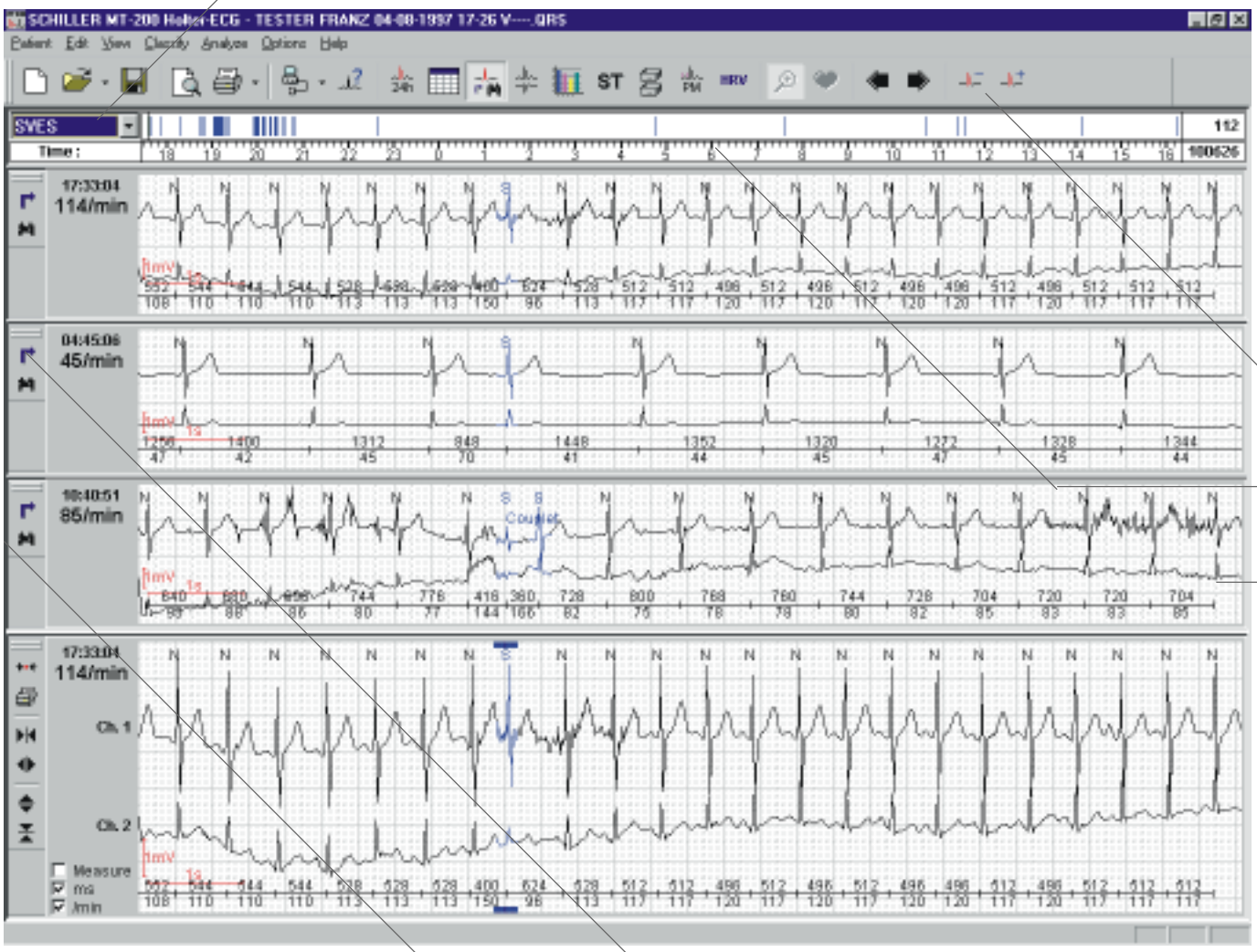
The three pages are selected by clicking on the page tabs at the bottom of the screen.

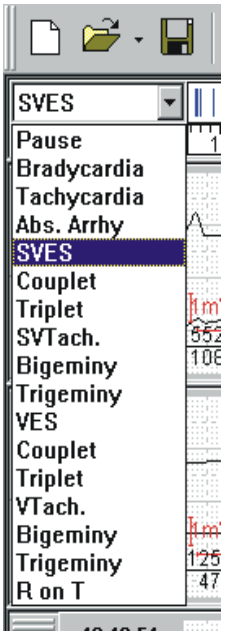
Click on any of the categories highlighted blue (e.g. longest bigeminy), to display the zoom view of the selected data in the lower part of the screen and to edit the ECG as required.

Click on the up/down arrows to scroll the table up/down to show further information.
Click on the left/right arrows to scroll the table left/right to show further information.

Event Samples View

Click on the Event Samples icon





Event Samples View and Printout

Up to three event samples are selected for every event category. After analysis, the three event samples are automatically displayed (one for each third of the recording), selected as follows:

- event 1 (top)- the first event in the recording
- event 2 (middle) - the first event detected after 8 hours
- event 3 (bottom) - the first event detected after 16 hours

If three or less events in a category are detected, then all of the events detected are displayed, regardless of where in the recording they occur. The event samples given here are also the samples given on the printout when the event samples box is checked in the print menu. The event categories are selected in the top right of the screen as shown.

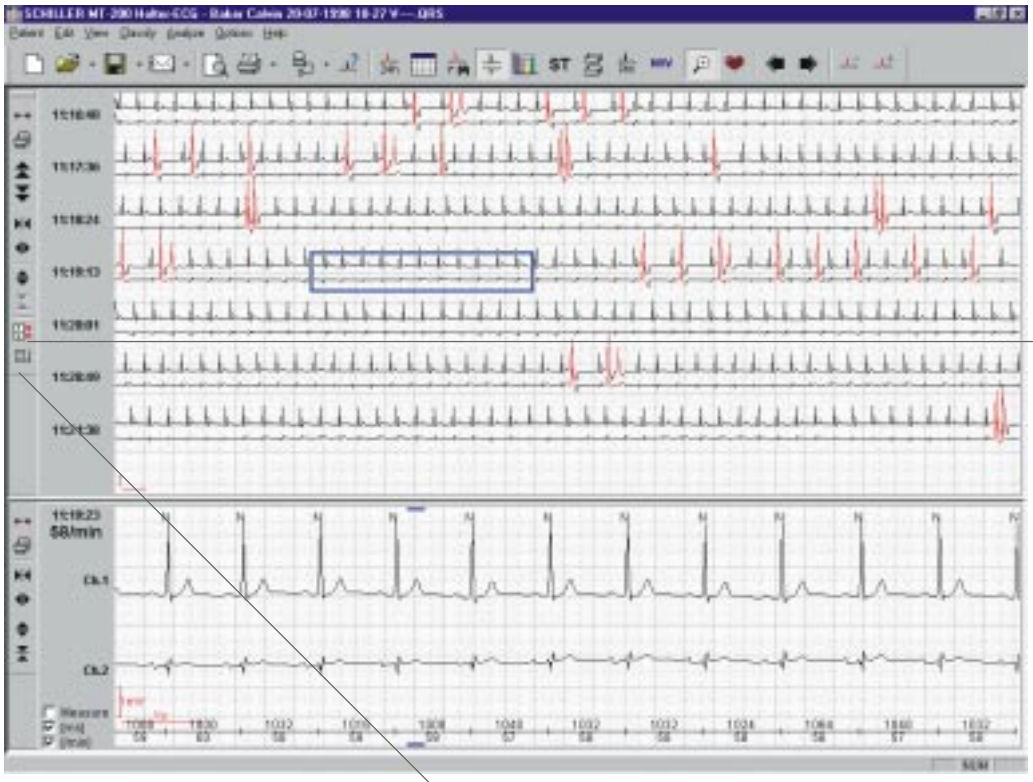
- **Use the `+ `and `- ` icons to zoom view the next previous event**
- **All events in the selected category are indicated by a vertical line. Click anywhere in this area display a zoom view the selected time.**
- **Click anywhere in the event to zoom view the event.**

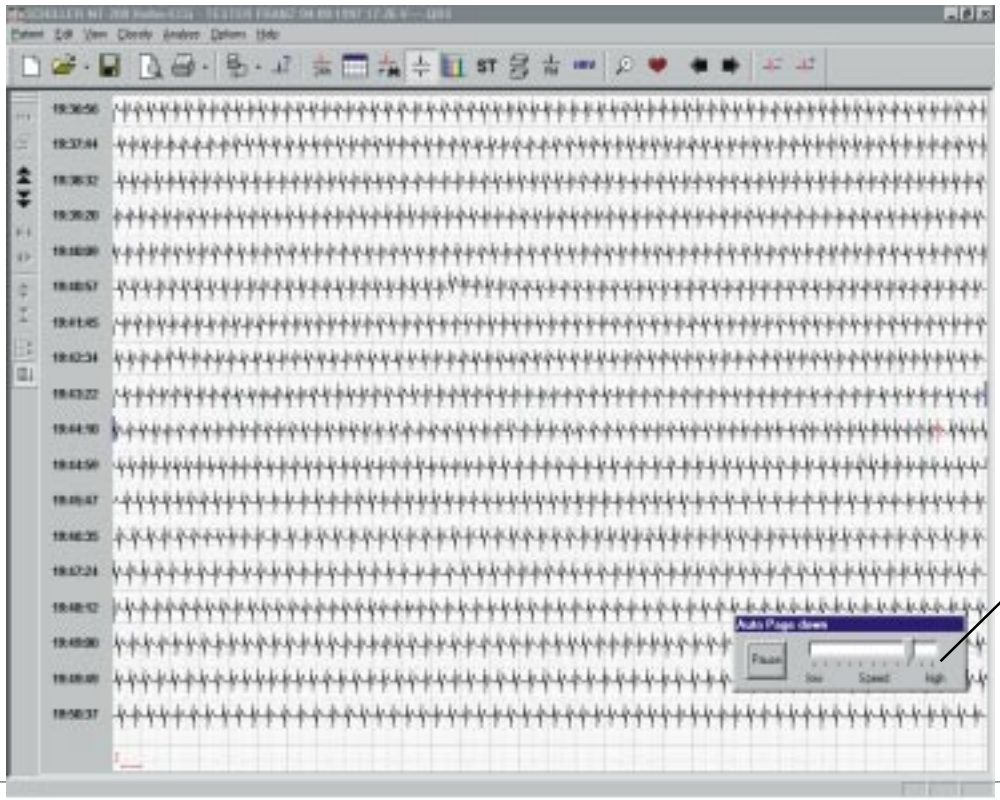
To manually select or change an Event sample:

- **Display the event in zoom view as described above.**
- **Click on the enter icon to store the selected zoom ECG section as an event sample.**
- **Click on the `next sample` icon to define the subsequent event as an event sample.**

ECG View (Rhythm)

Click on the ECG View icon





ECG View (Rhythm)

The time of the ECG recording is displayed on the left of each line on the upper screen.

The time segment of the ECG framed on the upper screen is zoomed on the bottom section of the screen.

When the cursor is positioned in the upper ECG screen, the cursor changes to a zoom cursor.

To zoom in on a particular segment of the displayed ECG, move the zoom cursor to the required ECG area in the upper screen and click with the left mouse button. The area highlighted on the upper screen is shown in zoom mode in the bottom section.

Click this icon to select the channels that are displayed. Select either channel 1, channel 2, or both.

Tip The maximum time span for a page in ECG view is approximately 60 minutes of ECG recording. If you wish to jump hours, it is easier to go into EVENT VIEW, reselect the time segment and then return to ECG view. Alternatively use the scrolling function.

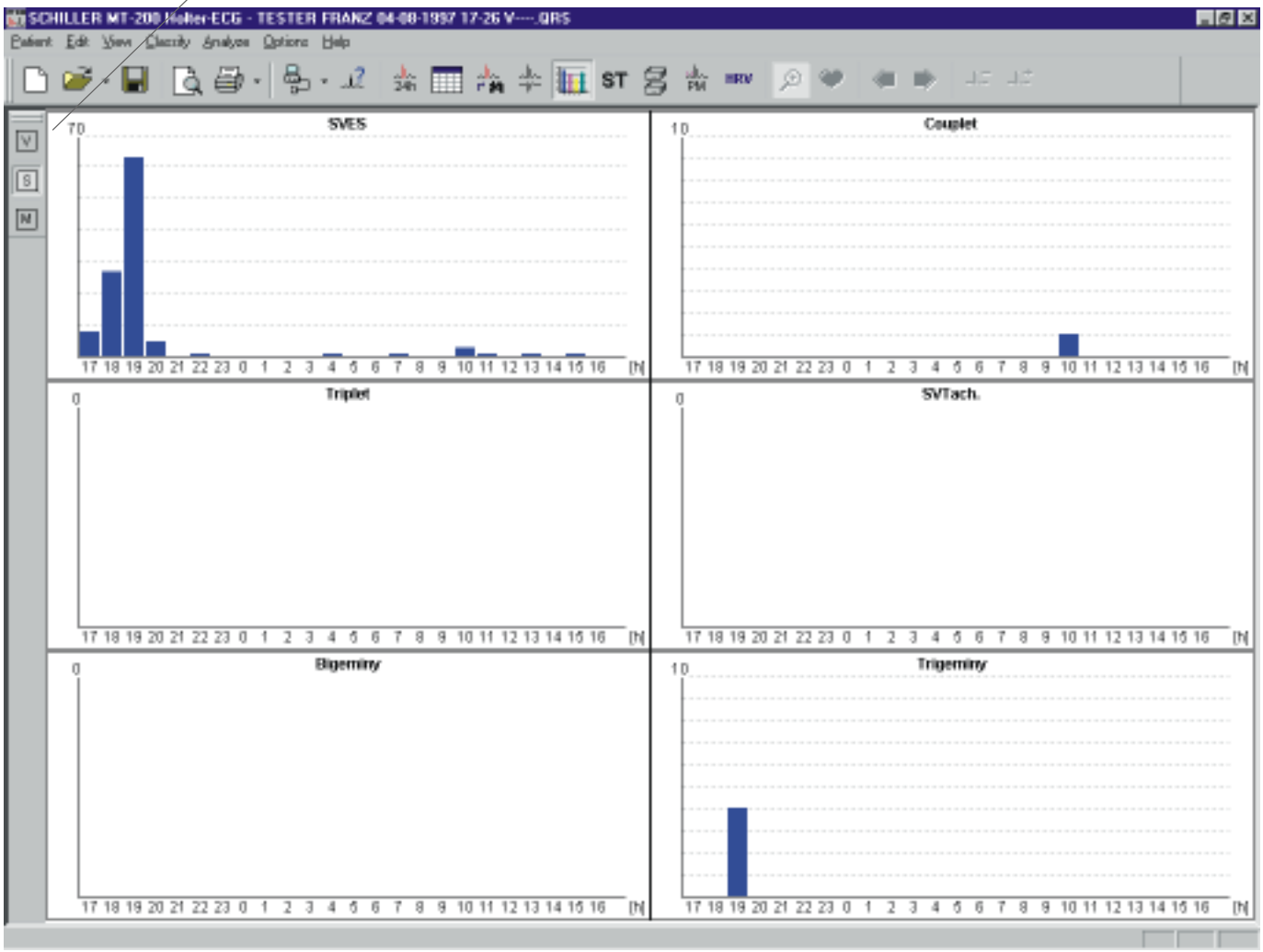
Auto Scrolling

- **Click on the Auto page down icon to page (scroll) through the complete recording.**
- **When selected a speed setting is displayed to define the scrolling speed. Adjust the speed to suit.**
- **To zoom in on a selected section and return to the top screen (stop scrolling), click with the zoom cursor . The zoom view of the selected section is displayed.**
- **During scrolling when the `pause` icon is clicked, manual page up and page down is possible with the page up and page down icons .**

  These are inactive during scrolling.

Bar Graph View

Click on the Bar Graph icon



Bar Graph View

The bar graph view provides an overview of all events over the entire recording. The X axis gives the hours (1 to 24) and the bar graph gives a visual indication of the events that occurred in that hour. The scale of the Y axis is automatically set for the number of events.

V **Ventricular arrhythmia** - Displaying graphs for - VES, couplet, triplet, Vtach., bigeminy, trigeminy

S **Supraventricular arrhythmia** - Displaying graphs for - SVES, couplet, triplet, SVtach., bigeminy, trigeminy

M **Miscellaneous -** Displaying graphs for - Marker (event button pressed during recording), lead-off, artifact, pause, bradycardia, tachycardia.

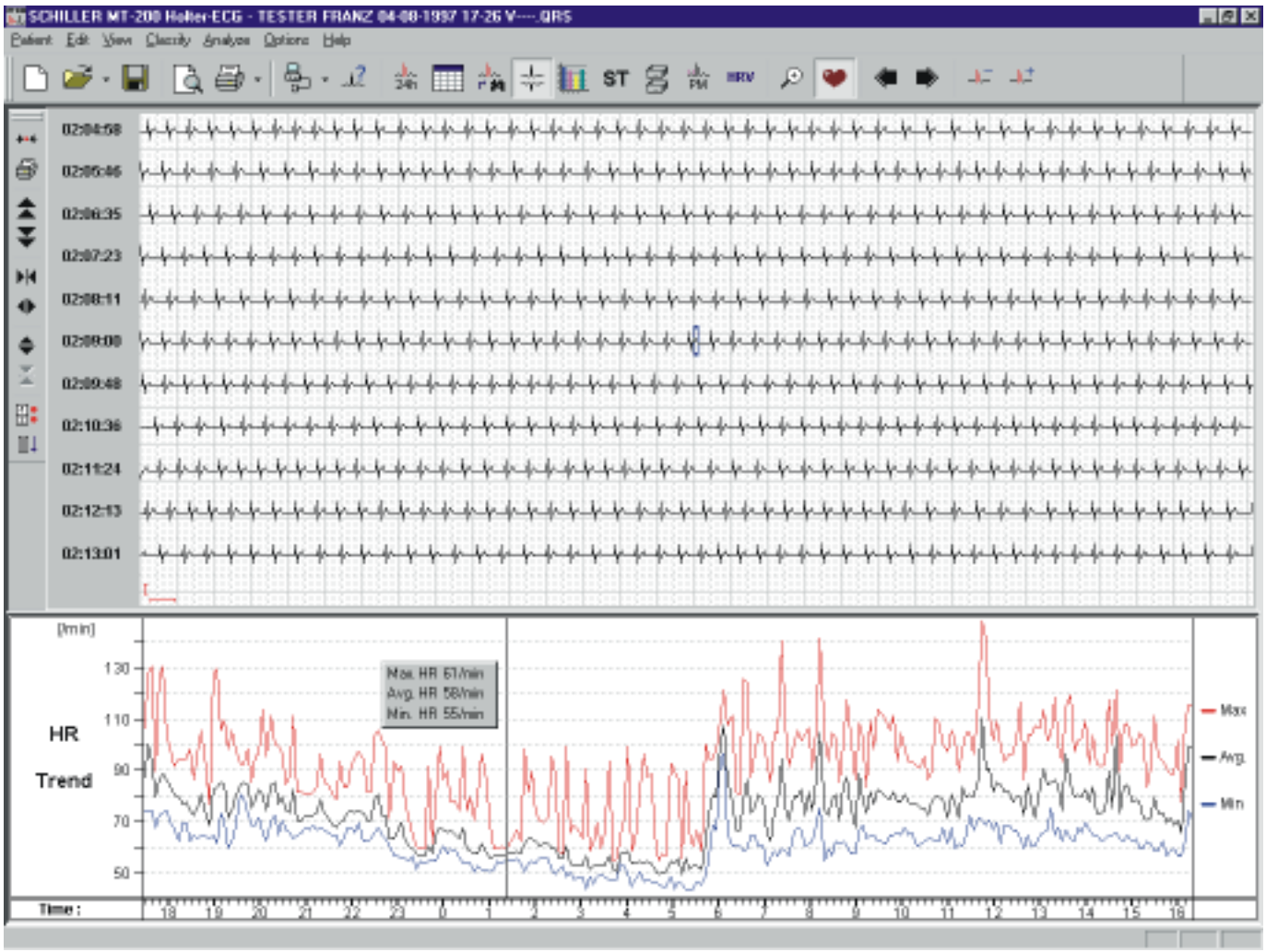
Three bar graph screens are available and selected by the three icons on the left side of the screen. Select and click with the mouse to change the bar graph screen.

Heart Rate View

The heart rate view gives the heart rate trend over the entire recording.

Note that the heart rate view can only be displayed from the ECG or Event view.

Click on the Heart Rate View icon



Heart Rate View

The heart rate for the entire recording is displayed in the bottom half of the screen. The time is shown on the bottom.

The heart rate is recorded every 1, 2, 5 or 10 minutes (see Section 4) with the red line giving the maximum heart rate, the black line the average and the blue line the lowest heart rate.

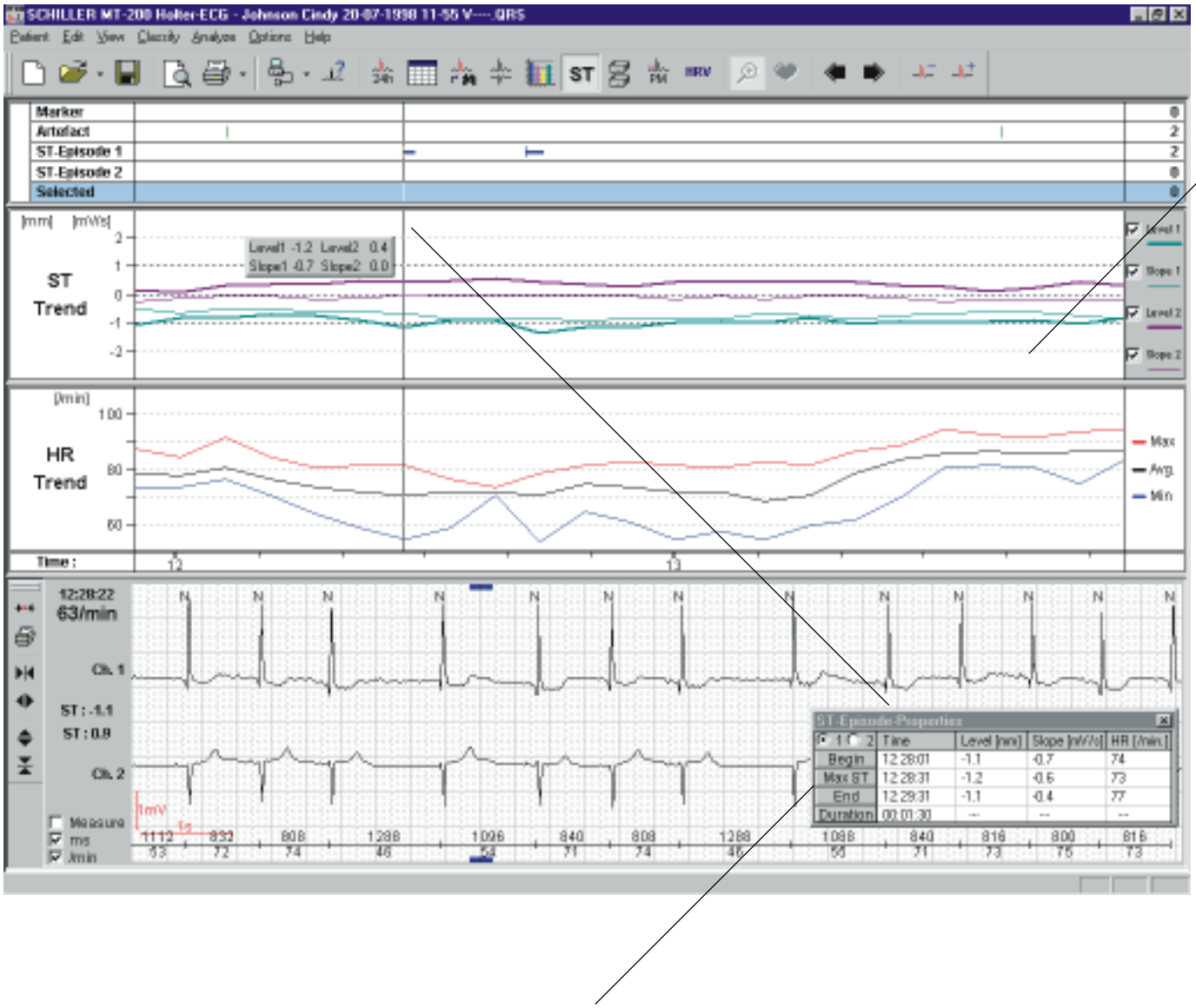
When the ECG view is displayed above, the vertical line in the heart rate trend indicates the time segment of the ECG displayed. Move the time segment of the ECG as follows:

Move the cursor anywhere in the HR view and click with the left mouse button. The vertical line is repositioned to the time indicated by the cursor and the time segment of the ECG view corresponds.

Return to the zoom view by clicking the zoom icon .

ST Trend View

Click on the St Trend icon



The measurements table gives the instantaneous values at the position of the vertical line in the top screen. Note that values are only displayed when the vertical line is positioned where an ST event has been identified (as indicated in the ST Espisode 1 & 2 event line). Clicking on any of the categories (`begin`, `max ST` or `end`) in the measurement table, displays the zoom view and values ***in the selected ST event episode.***

Limits for the ST episodes are defined in the analyze options.

ST Trend View

ST Episodes

The top section gives the incidents of artifacts and ST episodes for channel 1 and channel 2.

ST Trend

The middle section gives a graphical representation of the ST trends for both channels. The ST level is measured in mm and the slope is measured in mV/s (taken at the point (J-point +10ms to +100 ms) defined in `analyze options` (Sect 4)).

The scale of the level (mm) and slope (mV/s) are given on the left hand side of the trend graph.

The thicker line (+1, ±2 or ±3mm) indicated the current limit for ST episodes given in the analysis options.

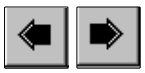
ST values in channel 1 are colored green, and in channel 2 colored pink. The ST level is the thicker line; the ST slope is the thinner line for both channels. Any of these four trends can be displayed or removed by checking the boxes to the right of the ST trend graph (level 1, slope 1 and level 2, slope 2)

Heart Rate Trend

See previous page

Zoom view

The zoom segment of the ECG at the time segment indicated by the position of the vertical pointer in the ST trend and heart rate graphs. Move to the next zoom page with the left and right arrows keys on the keyboard or the forward/backward scroll icons



ST Measurement Table

A measurement table of ST episode properties is displayed in the bottom right corner when the vertical pointer (line) is positioned at a point where an ST episode occurred. The table gives the following:

- the start and end time when the ST values exceeded the user defined value
- the ST value in mm at the start and the end of the ST episode sequence
- the ST slope in mV/s at the start and the end of the ST episode sequence
- the heart rate at the start and the end of the ST episode sequence
- the duration of the ST episode sequence

The measurement point where the ST values are measured is defined in `analysis options` in the `Settings` section

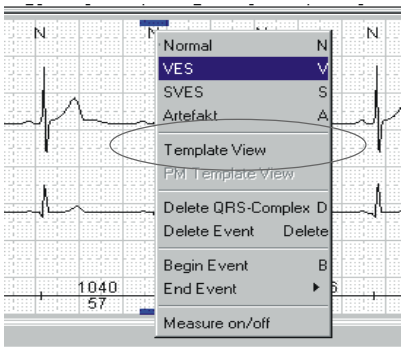
To reposition the vertical pointer:

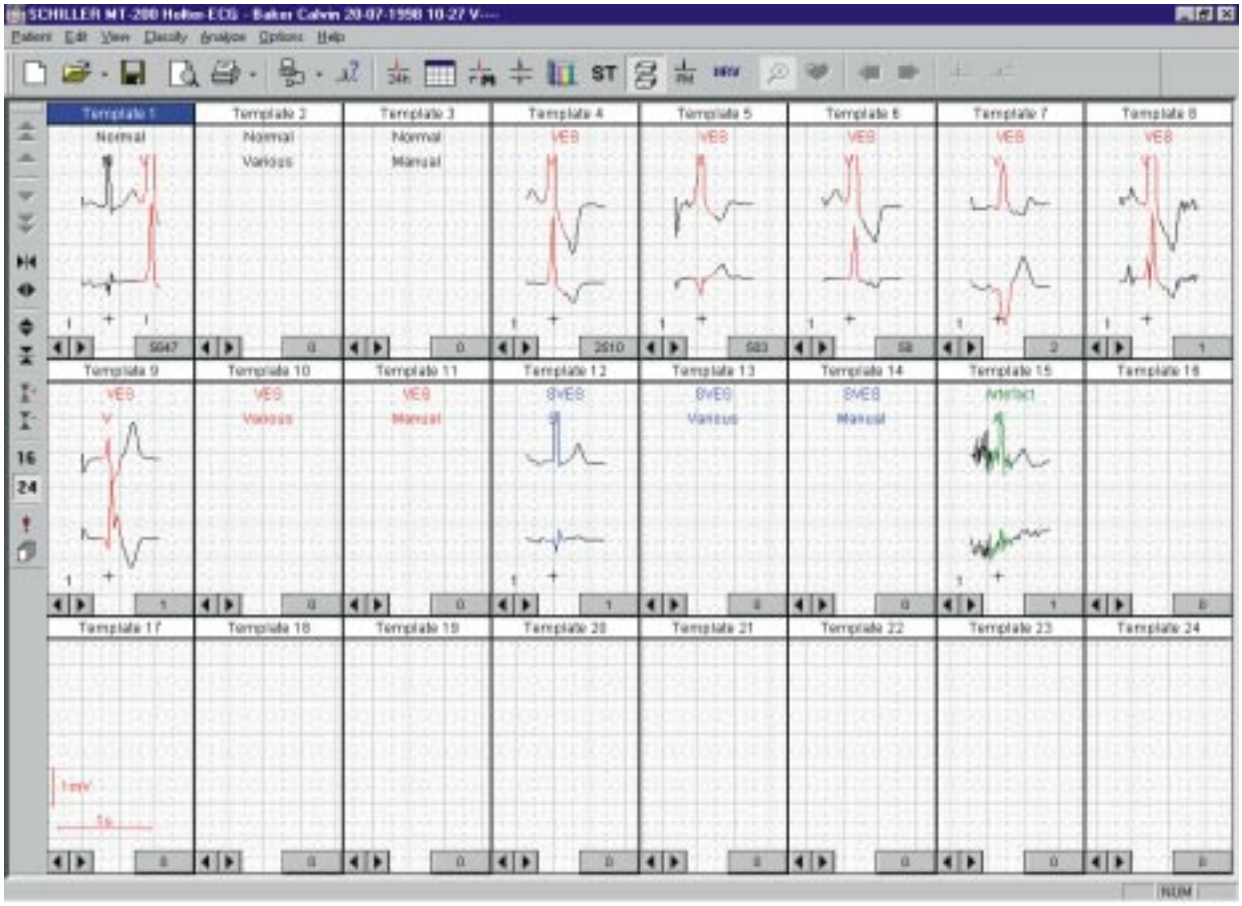
Move the cursor with the mouse anywhere in the HR graph, the ST trend graph or the ST episode section, and click with the left mouse button. The vertical line is repositioned to the cursor position.

Template Matching

Click on the Template icon

It is also possible to enter the template view and directly highlight a (classified `N`, `V`, `S` etc.) template class from the zoom view. Click with the right mouse button and select template view. The template class of the selected complex is highlighted.





When an ECG is measured over many hours differences will naturally occur in the QRS complexes. These varying QRS complexes can be measured and the shaped grouped as one class or **template.** There can be several classes in which the QRS complex is considered normal, several classes with an abnormal QRS complex (ventricular extrasystoles, VES classes) and also classes with disturbed QRS complexes. The user therefore can have a direct overview of the different kinds of electrical activity in the heart. It is also possible to immediately reclassify a complete group of QRS complexes that are considered to be incorrectly classified.

The Schiller software can differentiate between 12 normal templates, a maximum of 300 abnormal templates, one artifact template and up to 12 supraventricular templates; the templates are shown in frequency (number of occurrences) order; the number of occurrences is displayed in the shaded box in the bottom right of the template (see next page). The first templates displayed are the normal templates followed by the VES templates. If less than 12 normal QRS forms fit the templates, then only those measured are displayed (as in the example with 3 shown).

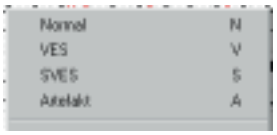
Template Matching

Disturbed complexes that are still considered to be normal and complexes that do not fit into any other templates are collected under `normal various`. When the user manually reclassifies a QRS complex as normal, it is shown in the template as `Normal Manual`. The VES templates are shown after the normal templates.

The Schiller template matching subdivides the QRS complexes recognized as normal or SVES into different subgroups. This very exact analysis differentiates the normal QRS complexes when relatively small shape differences appear. This enables the reclassification of abnormal complexes that appear very similar to the normal QRS complexes and may therefore be incorrectly labelled as normal by the algorithm. They can be reclassified as VES in one group, using a single command.

QRS complexes which have such extreme disturbances that no clear allocation as normal or VES is possible, are collected in the artifact template.

Using the right mouse button, each template class can be reclassified as normal, supraventricular (SVES), VES or artifact. A template class can also be deleted.



When two templates are assessed to be equal, one template can be `dragged and dropped` into the other. Hold the left mouse button on the template to be merged. Still holding the mouse button, move the mouse to position the QRS in the template area of the similar template. Release the mouse button to merge the two templates. Some special icons are associated with template matching:

Go to previous or next page of templates. Go to last or first page of templates

Increase or decrease speed

Increase or decrease amplitude

Increase or decrease distance between the two leads shown on each template

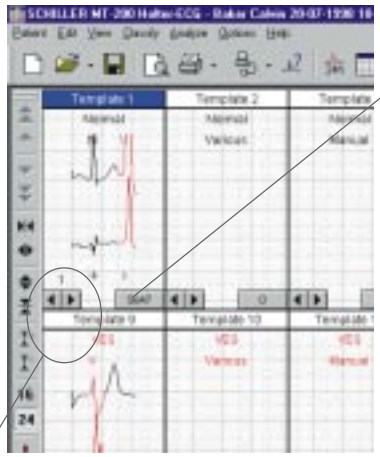
Display 16 or 24 templates per page

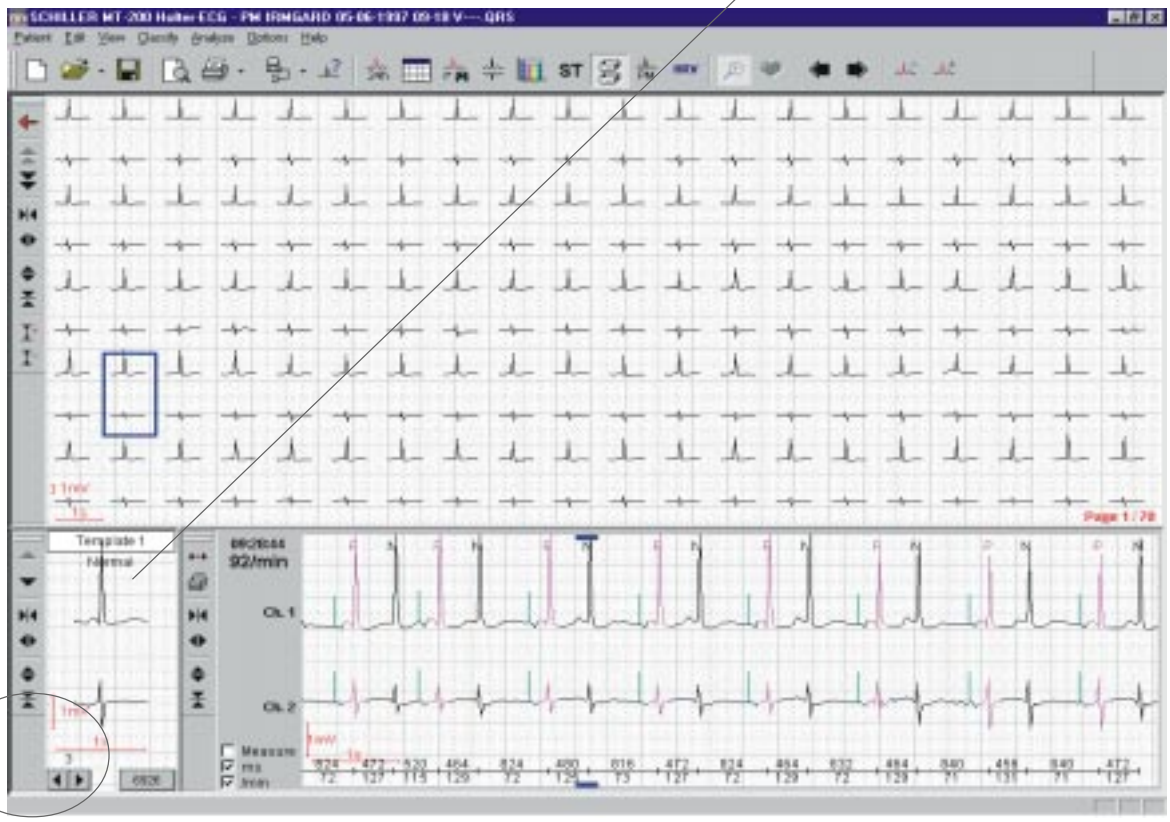
To limit the number of VES templates after evaluation, click on the `limit VES` template icon. The templates which are no longer required are collected under the templates `VES Diverse`. Note that the default number of VES templates is set in the analysis menu (see chapter 4).

Rearrange the templates (after editing)

Detailed Overview of the template classes

To obtain a detailed view of the template classes click on the number of occurrences box at the bottom of the templates.





A reference QRS complex of the template group is displayed in the bottom left. In this way the zoomed QRS complex can be visually compared with the reference complex of the template. The reference complex number is displayed in the bottom left corner of each template and is changed with the left and right arrows (previous QRS/ next QRS). When the template view is exited, the same reference complex is set on reentering.

Template Matching

The upper part of the screen displays all complexes of the selected template. A maximum of 100 QRS complexes can be shown on one page. Select the next / previous page(s) with the icons on the left (see previous page).

A zoom view of any QRS complex is displayed in the bottom section. To select another zoom view position the cursor on any complex (in the top section of the screen) and click. The selected section is zoomed in the bottom section.

The selected QRS complex in either the top section of the screen or the zoom view, can be reclassified by clicking with the right mouse button, or directly using keys `N`, `V`, `S`, `A`, or `D` (delete)

To reclassify the whole template, position the mouse on the reference QRS complex, and click with the right mouse button to display the above menu.

All event results (couplet, triplet, bigemus, etc.) that have changes with manual reclassification, are automatically updated when the template view is exited and reentered.

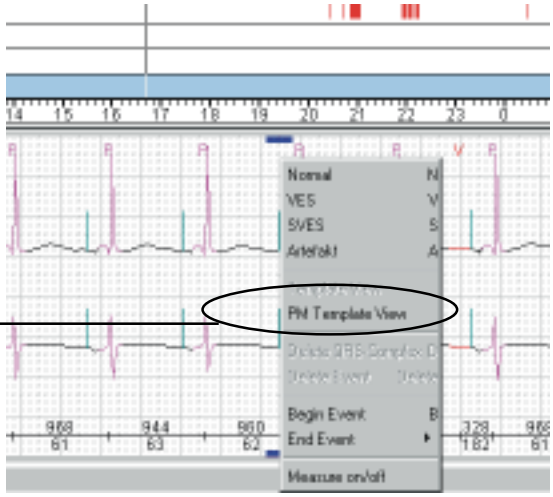
A measurement box is displayed in the zoom view when the measurement display box in the bottom left of the zoom screen, is checked. This gives the amplitude and time difference between the two horizontal blue lines. The two blue lines can be positioned anywhere on the zoom view by moving with the cursor - the measurement values instantly change - see page 2.9.

The two lower settings situated in the bottom left of the zoom screen display the measured time and heart rate when checked and indicate:

- the time in milliseconds between respective heart beats
- the heart rate calculated beat to beat

Pacemaker Templates

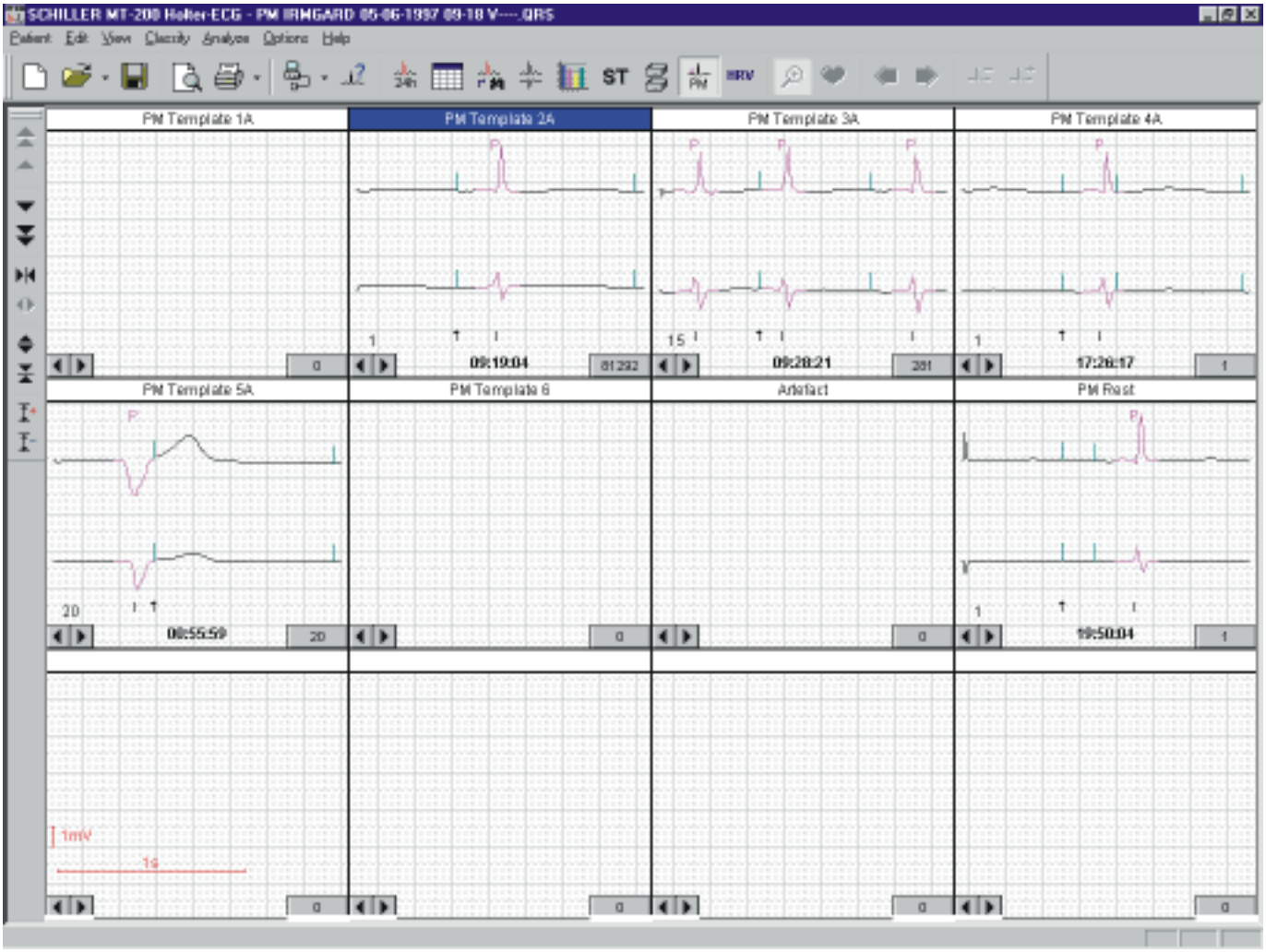
Click on the Pacemaker template icon



It is also possible to enter the template view and directly highlight the selected template class from the zoom view. Click with the right mouse button and select template view. The template class of the selected complex is highlighted.

When the 24hr view is selected

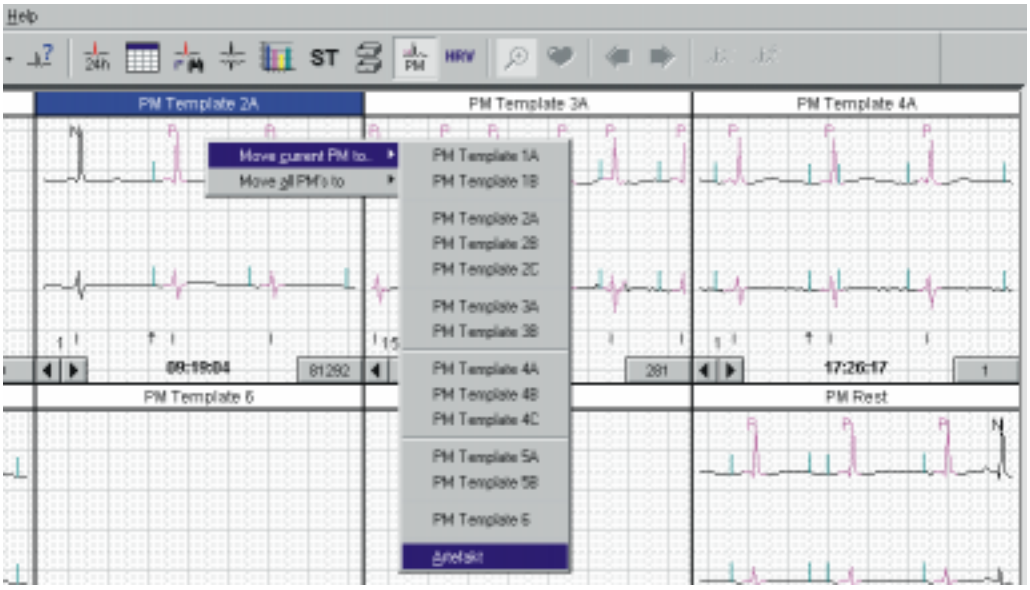
with a pacemaker template highlighted, the zoom view displays the selected pacemaker pulse. In this view normal editing functions are available.



Pacemaker Templates

Individual PM templates or the complete class of PM template can be moved into another PM Template using the right mouse key:

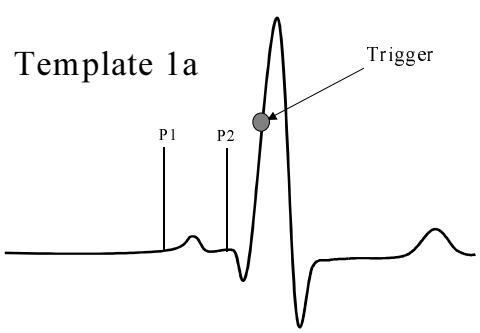
Note that user defined names can be defined for all pacemaker templates - see section 4.

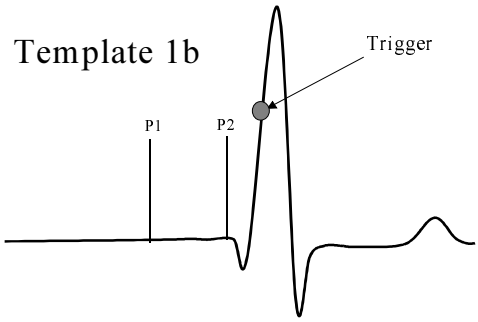


Template Classes

The Pacemaker template option provides an evaluation of the Pacemaker Impulses with a graphical display of the responses. Eight different Pacemaker Templates are defined :

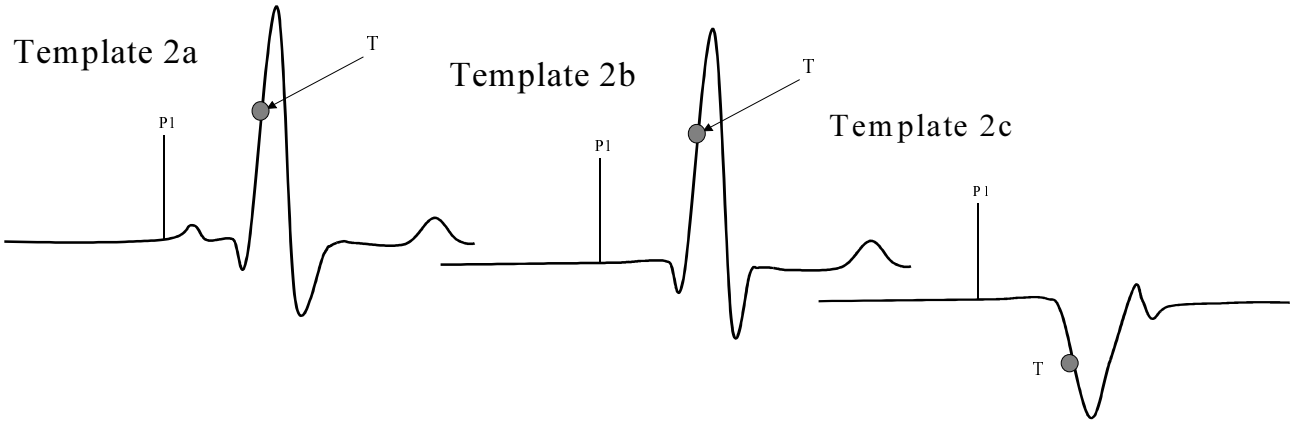
Template 1: Two pacemaker pulses P1, P2 are detected; the distance between the two PM actions is greater than 100 ms and less than 220ms. The QRS Trigger T is after the second PM Pulse P2.



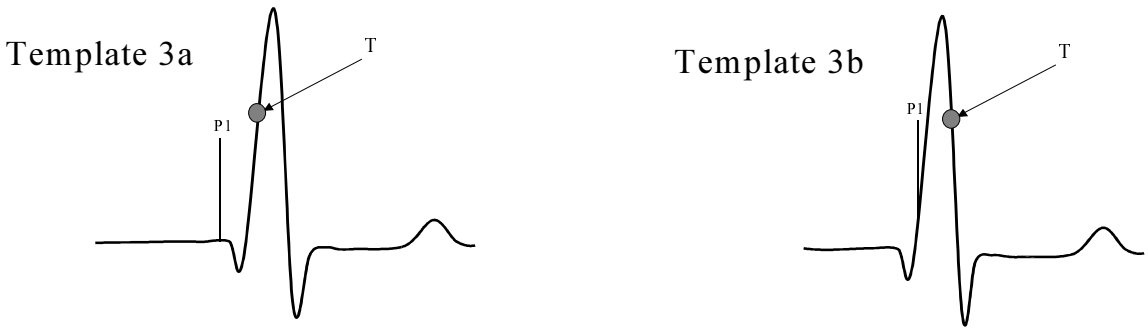


Pacemaker Template

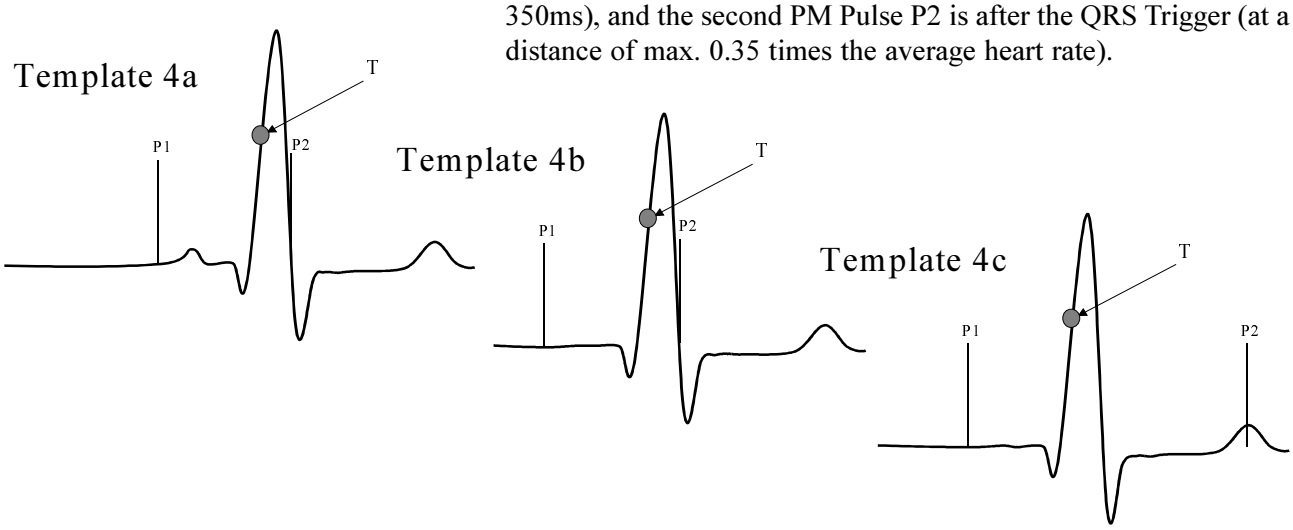
Template 2: One pacemaker pulse P1 is detected, and the QRS Trigger T is after P1; the distance between PM Pulse and QRS Trigger is greater than 150ms and less than 350ms.



Template 3: One Pacemaker Pulse P1 is detected, and the QRS Trigger T is after P1; the distance between PM Pulse and QRS Trigger is less than 150ms.



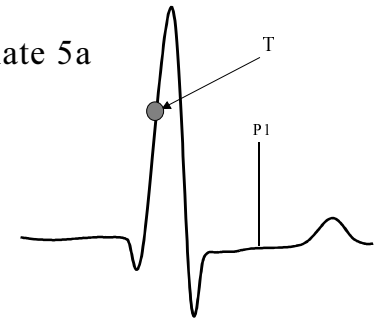
Template 4: Two pacemaker pulses P1, P2 are detected, and the first PM Pulse P1 is before the QRS Trigger T (their distance is greater than 150ms and less than 350ms), and the second PM Pulse P2 is after the QRS Trigger (at a distance of max. 0.35 times the average heart rate).



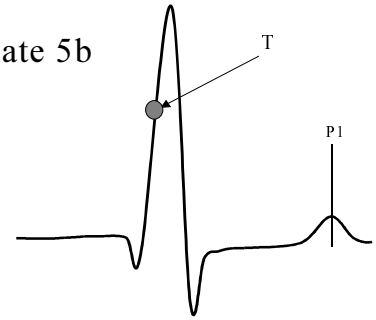
Pacemaker Template

Template 5: A Pacemaker Pulse P1 detected after the QRS Trigger T at a distance of up to 0.35 times the average heart rate (in the ST Segment).

Template 5a

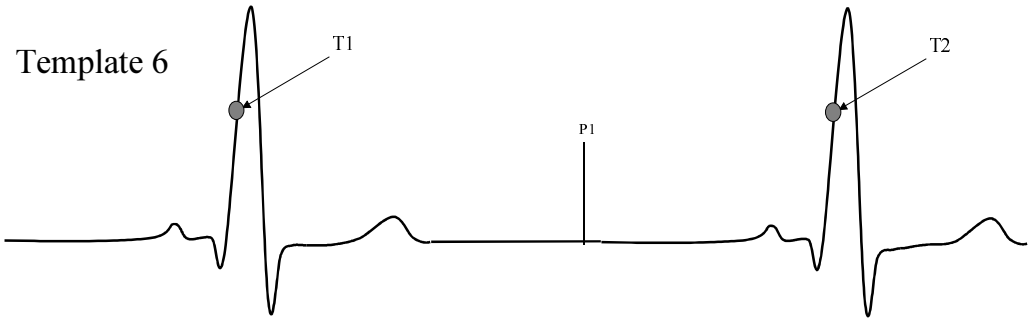


Template 5b



Template 6: Pacemaker Pulse(s) detected between two QRS triggers: the distance of the PM Pulse to the previous QRS Trigger is greater than 350ms and the distance to the next QRS Trigger is greater than 0.35 times the average heart rate.

Template 6

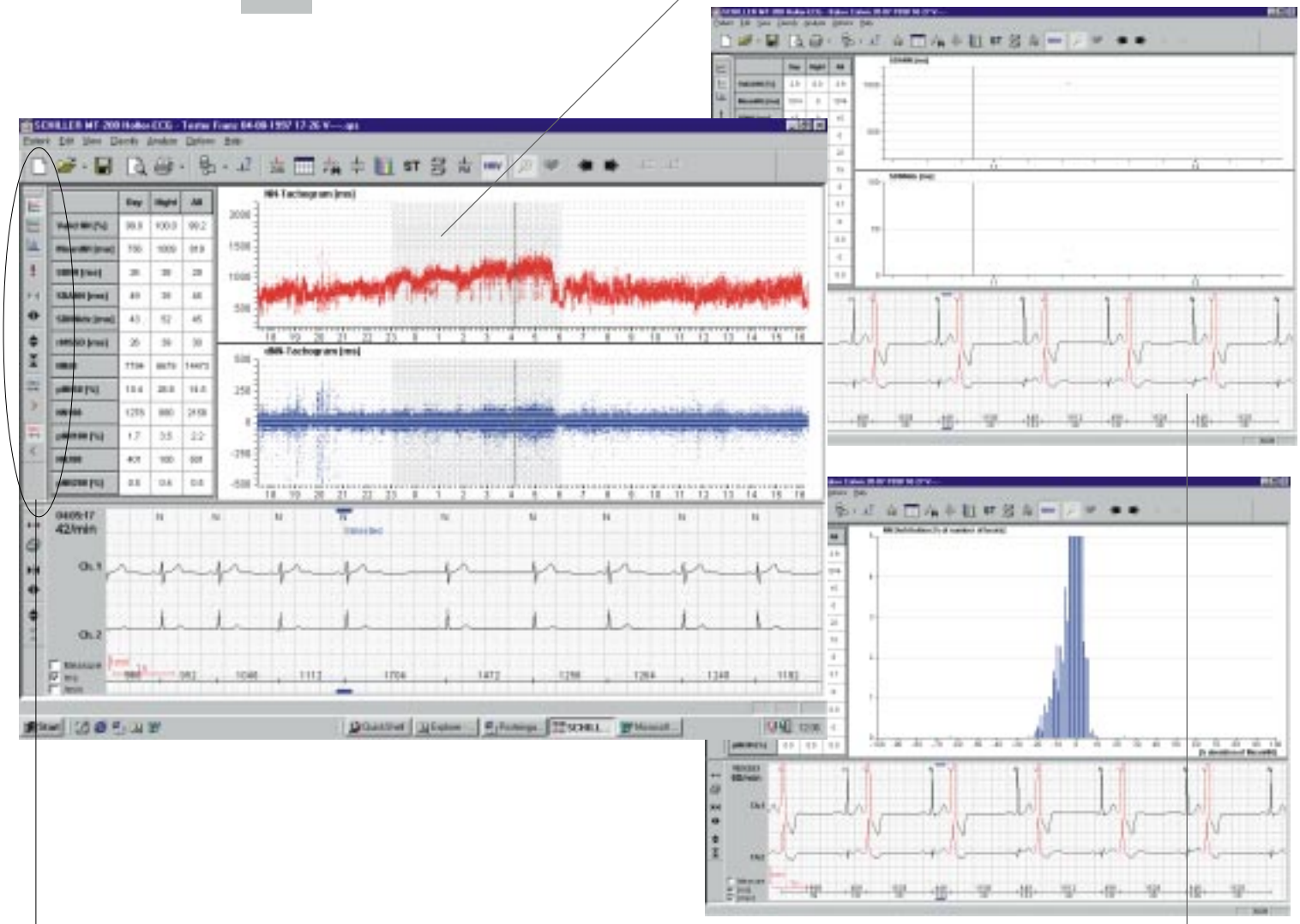


Template PM Rest In this template are all the pacemaker pulses that could not yet be assigned to any of the other PM templates.

Template Artifact: The user can assign all triggers here in which a pacemaker action was incorrectly recognized by the system due to artifacts.

Pacemaker settings and options are described in the `Settings` section.

Click on the HRV icon



Select three different graphical representation of the HRV with the three top icons:

NN Tachogram Distribution over the entire recording of absolute and relative intervals

SDANN Graph Distribution over the entire recording.

NN Distribution Bar graph showing percentage of NN beats against the percentage deviation from the mean.

Update the graphical representation after, for example changing a setting

Scale down X-axis

Scale up X-axis

Scale down Y-axis

Scale up Y-axis

Go to the point in the recording of the minimum (shortest) NN interval.

Go to the point in the program of the next longest NN interval.

Go to the point in the recording of the maximum (longest) NN interval.

Go to the point in the recording of the next shortest NN interval.

Heart Rate Variability

The darkened area indicates the nighttime setting.

Heart Rate Variability Analysis Notes

- RR intervals before and after a VES are not considered for the calculation of the heart rate variability. Only time intervals between normal QRS complexes, i.e. so-called NN intervals, are used.
- HRV analysis is made on 5 minute intervals. When a compliance ratio of less than 80% of NN intervals within a 5-minute interval exists, this time interval is not used for the calculation.
- When an absolute arrhythmia is detected, all the QRS complexes during this absolute arrhythmia are not accepted for HRV analysis.
- For a correct evaluation it is important that no normal QRS complexes are overlooked. Also, disturbances or VES should not be incorrectly designated as normal QRS complexes (falsely recognized as normal beats).
- To enable the analysis to be as accurate as possible with regard to the foregoing and to enable the program to detect falsely triggered QRS complexes the following functions are provided in the screen display for the user to control the automatically calculated trigger point: maximum NN interval, and all subsequent maximal NN intervals, minimum NN interval, and all subsequent minimal NN intervals.

The following parameters* are analyzed in tabular form for the entire 24-hour recording, separately for day and night time (beginning of night time and beginning of day time can be entered in the patient/ recording data)

Valid NN The percentage of valid NN used in the analysis.

Mean NN The average value of all intervals between consecutive normal QRS complexes within the entire ECG recording (also specifically for day and night) .

SDNN (standard deviation of mean NN). The standard deviation of all intervals between consecutive normal QRS within the entire ECG recording (also specifically for day and night).

SDANN (standard averaged deviation of NN). The standard deviation of calculated average values After splitting up the entire recording into 5-minute segments, the average values of the intervals between consecutive normal QRS complexes within these 5-minute segments are calculated.

SDNNidx (standard deviation of NN intervals). After splitting up the entire recording into 5-minute segments, all standard deviations of intervals between consecutive normal QRS complexes within the 5-minute segments are calculated. The average value of these standard deviations gives the SDNNidx.

rMSSD (root mean square of successive differences). All differences between consecutive NN intervals are raised to the power of 2 and summed up. This sum is normalized to the number of actual differences and the square root taken from this value gives the rMSSD.

NN50 The sum of all congruent NN with variations greater than 50ms. The intervals between consecutive normal QRS complexes are determined from the entire ECG recording (NN interval). The differences between successive NN intervals are calculated and all differences greater than 50ms summed.

pNN50 Proportion (percentage) of adjacent NN-intervals with variations greater than 50ms calculated against the total number of NN intervals.

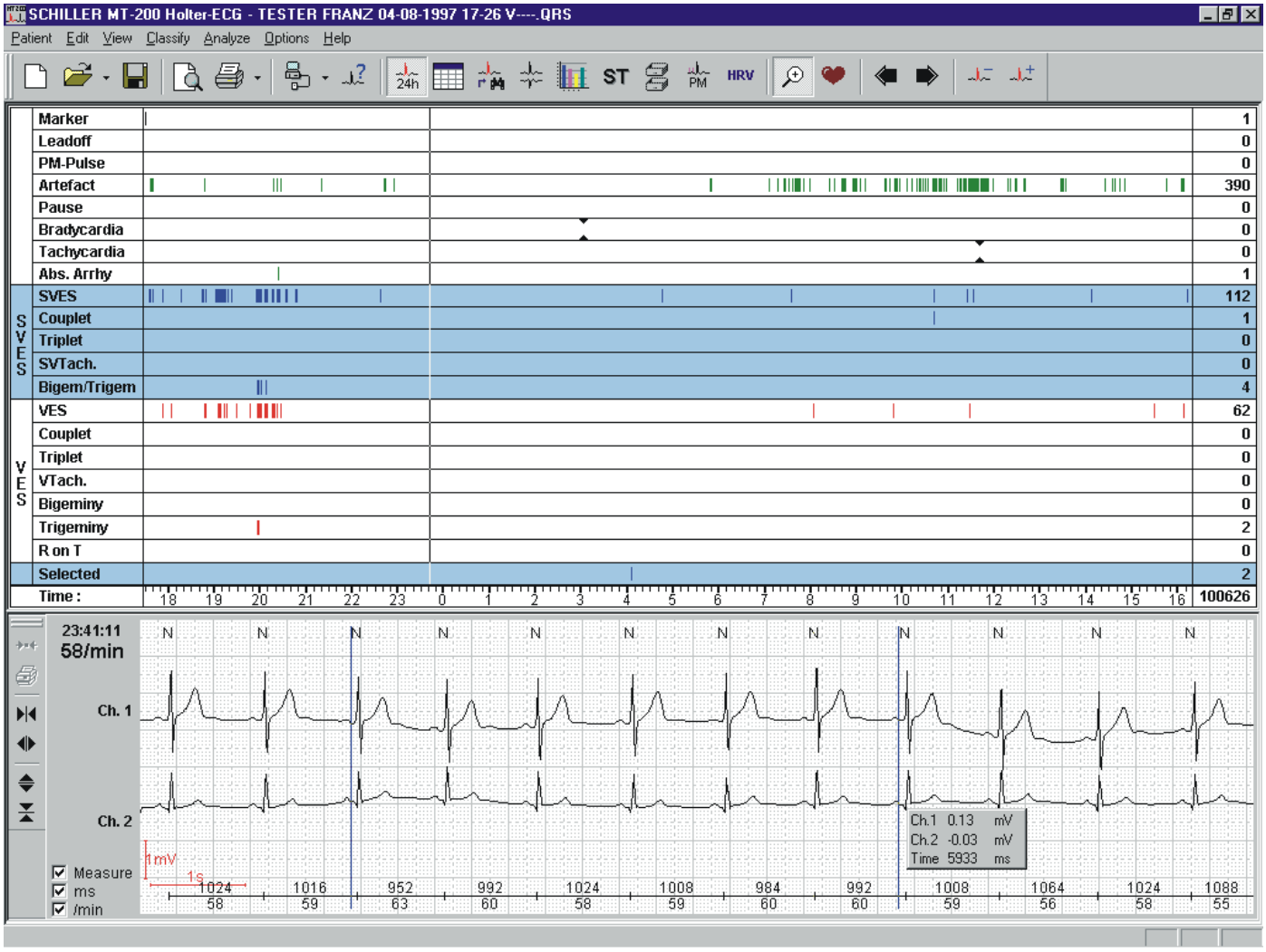
NN100 / NN200 Same as NN50 but with a time difference greater then 100ms and 200ms respectively.

* *Parameters analyzed according to: Standards of Measurement, Physiological Interpretation, and Clinical Use of Heart Rate Variability; Task Force of The European Society of Cardiology and The North American Society of Pacing and Electrophysiology, Confidential Draft, July 1994.*

Reclassifying/Editing a QRS Complex

In the Zoom view (which can be selected when in Rhythm View and Event View, and is always displayed in ST trend) it is possible to reclassify a QRS complex.

Two horizontal thick blue lines are position in the zoom view above and below the two channels. To reclassify an individual complex proceed as follows:



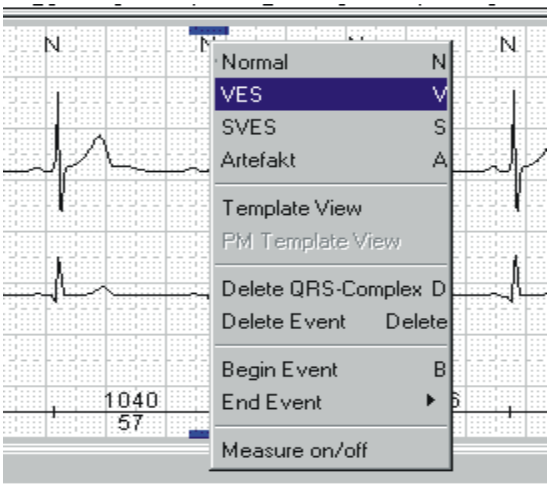
1. **Click anywhere in the lower screen to move the two blue horizontal lines. Position the two lines above and below the QRS complex that you wish to edit**

Reclassifying/Editing a QRS Complex

2. To reclassify the selected complex either:
Double click with the left mouse button
The following screen is displayed:

OR
Display the Classify Menu by:
Clicking the right mouse button OR Opening the Classify menu in the main menu bar

3. Select the QRS type to which you wish to reclassify the complex.



The classification is applied to the QRS complex selected. This includes the color change and inclusion in the relevant event table.

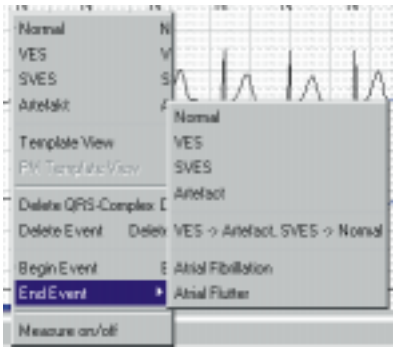
Classifying a Group of QRS Complexes

A group of QRS complexes can be classified as follows:

° **Enter the ECG view and in zoom view click the right mouse button and select `begin event` at the beginning of the event.**

° **Go to the position in the recording where the event ended.**

° **In the zoom view click the right mouse button and select `end event`. A number of classification options are available. Select `Normal`, `VES`, `SVES`, `artifact` as required.**



The VES>artifact and SVES>normal option will reclassify all VES to artifacts and all SVES to normal QRS complexes in the selected time period.

Accelerator Keys

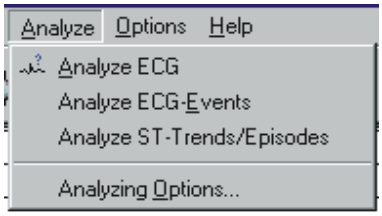
1. Position the two blue horizontal lines above and below the complex as detailed above.

2. Press one of the following accelerator keys to reclassify the complex.

KEY `N` Classify the selected QRS complex as NORMAL
KEY `V` Classify the selected QRS complex as VES
KEY `S` Classify the selected QRS complex as SVES
KEY `A` Classify the selected QRS complex as Artifact
KEY `D` To DELETE the selected QRS complex
KEY `B` Mark the selected QRS as the beginning of an artifact
KEY `E` Mark the selected QRS as the end of an artifact

Analyzing/Reanalyzing the Recording

The analyze options are given in the analyze menu:



Analyze ECG

Select this option to reanalyze the current file with respect to the currently set analysis parameters. Analysis of a complete recording may take several minutes. All events that have been manually reclassified are lost.

Analysis of a complete recording is also initiated with the analysis icon:

Analyze ECG Events

Select this option to recalculate all event information. Selecting this analyze option is quicker than the analysis of the complete ECG. Events manually reclassified are included in the event table. QRS complexes which have been manually reclassified remain unchanged.

Analyze ST Trends

Select this option to recalculate all ST trend data (levels and slope) and episodes. Selecting this analyze option is quicker than the analysis of the complete ECG. QRS complexes which have been manually reclassified remain unchanged.

Analyze Options

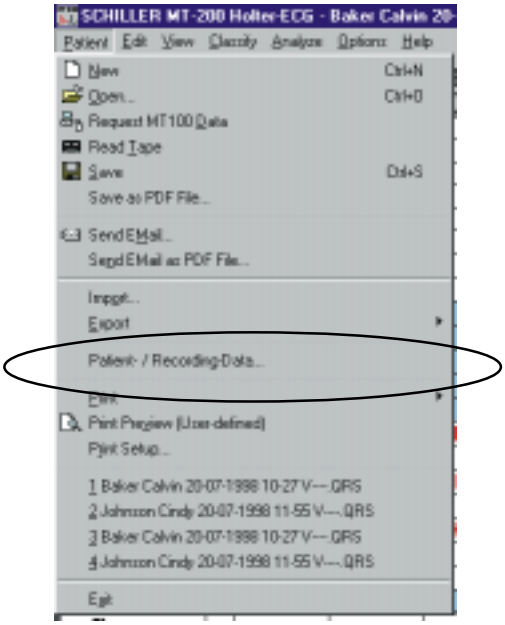
This gives the calculation analysis parameters that are used for all new recordings, and when reanalyzing a previous recording. Details of the analysis measurement settings are given in the Settings.

Editing Patient Data / Recording

Enter the patient /recording edit screens to carry out the following:

- Edit patient data - name, weight, height, DOB etc.
- Edit the date / time of the recording
- **View the settings that were used for the analysis of the current recording**
- Enter medication, diagnosis, comments etc.

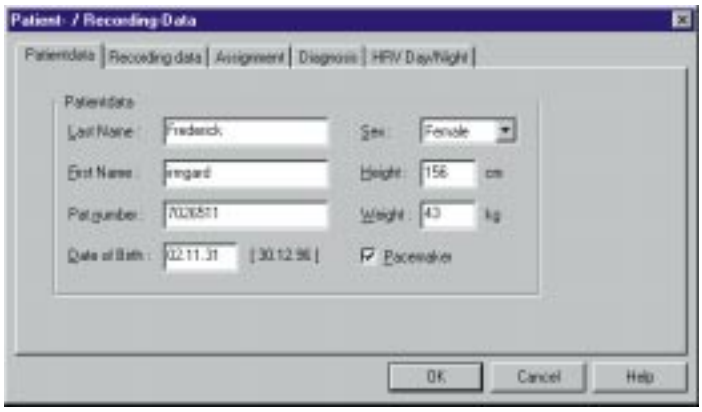
With any of the patients recordings displayed, enter the patient recording data screen from the Patient menu. Select the patient / recording data option as shown below.



At the top of the screen are five tabs which select sub screens for data entry as shown on the following page.

Editing Patient Data / Recording

Patient Data



Enter or edit the patient details. :

- Name
- Number
- Date of Birth *
- Sex
- Weight
- Pacemaker - fitted or not

If pacemaker pulses are to be detected (and displayed) in the recording the pacemaker box must be checked here - see Section 1.

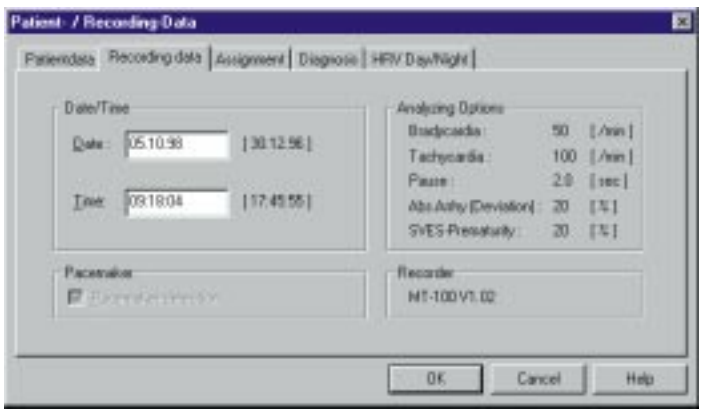
* To ensure year 2000 compliance it is important to note the following:

The date of birth can be entered in two ways:

1. The year is entered using two digits only - the program calculates the date of birth automatically with the current PC date. Patients age is always between 1 and 99 years.
2. The year is entered using four digits - patients can be 100 years or older.

In both cases the program stores the date of birth as a four digit value.

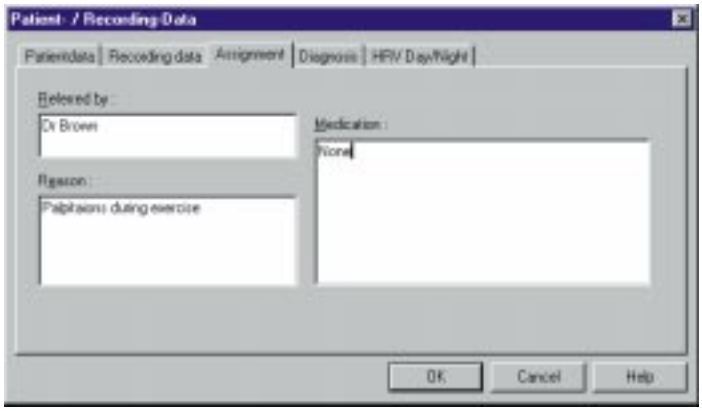
Recording Data



In this screen you can enter/edit date and time of recording. This screen also gives the analyze settings (options) used in the recording analysis.

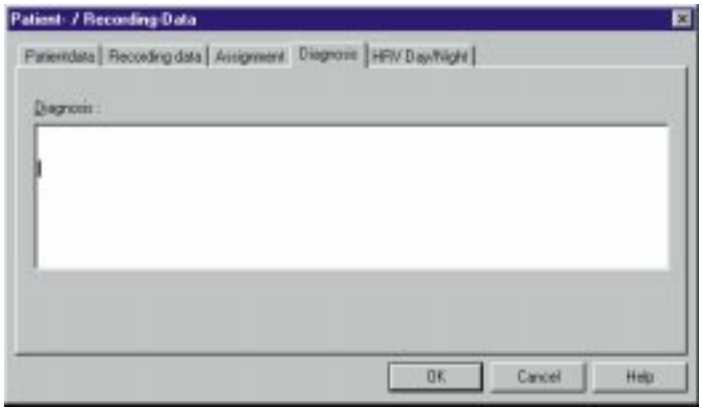
Editing Patient Data / Recording

Assignment



In this screen you can enter/edit Referral details and medication.

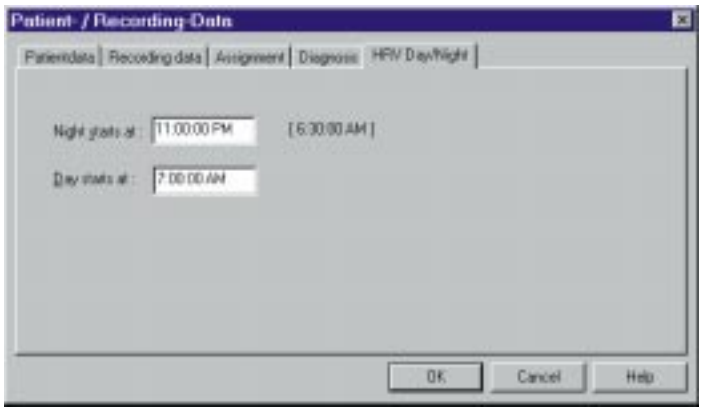
Diagnosis



This gives a text entry field for entry of diagnostic analysis and/ or comments.

When a printout of the analysis summary is obtained, the diagnosis and comments are included on the same page

HRV Day/Night



The defines the start of the day and night periods for HRV analysis.

Manually Deleting a Recording

Note: Recordings can be automatically deleted when between 5 and 100 have been stored. To set the auto deletion function see the Settings section.

A complete 24 hour recording requires approximately 8 Mbytes of storage space which is stored automatically after downloading from the Holter recorder. This means that your hard disk can quickly fill if recordings are not deleted when they are no longer required.

Recordings can be deleted at any time. For every recording there are two files (xxx.cmp and xxx.qrs). Both of these files have to be deleted when removing a recording. To delete a recording proceed as follows:

1. **Open the Windows Explorer - click the windows START icon at the bottom of the screen > programs > windows explorer.**

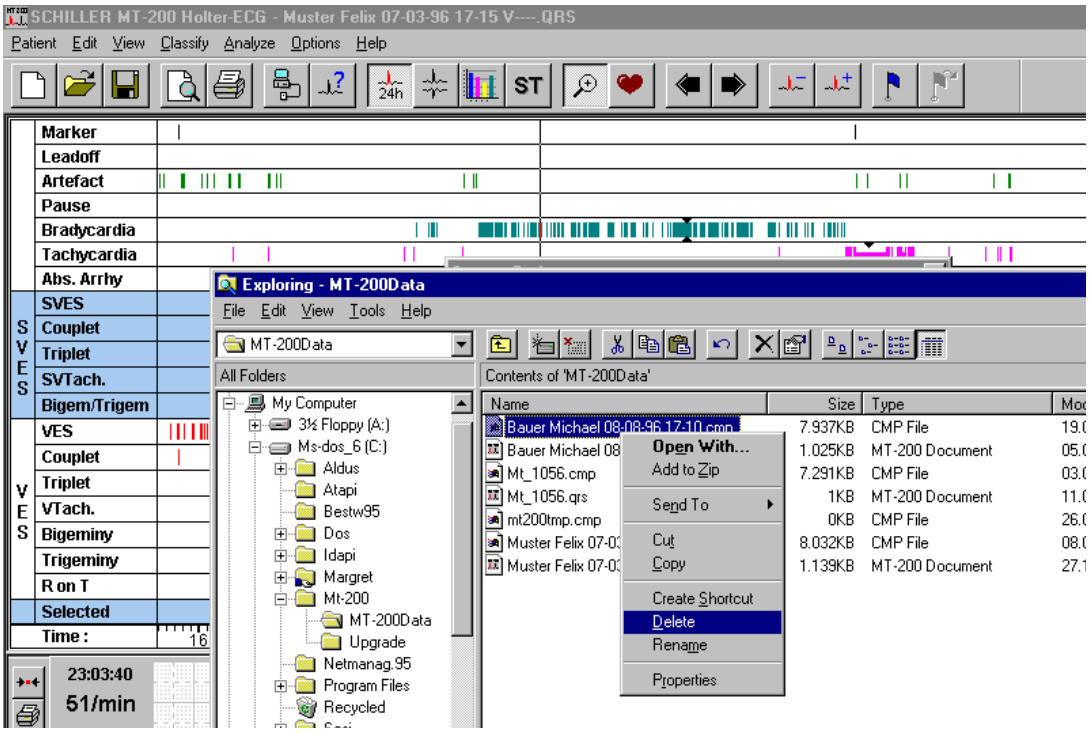
2. **Open the MT-200 folder and then the MT-200 Data folder. (If you have specified another location for the storage or recordings, obviously open that folder)**

3. **Select in turn the two files (xxx.cmp and xxx.qrs) of the recording that you wish to delete**

4. **Press the right mouse button to display the explorer menu**

5. **Select the `delete` menu item and click with the right mouse button**

Deleting a Recording



6. Confirm deletion

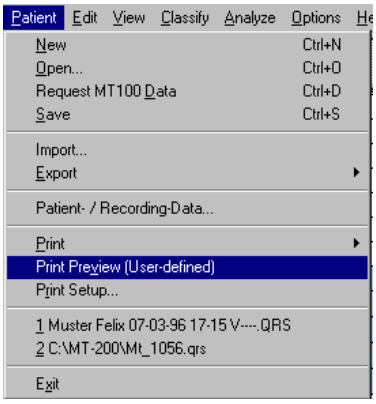
7. Empty the Paper bin when you are sure that the recording will not be required again

Print Preview

Define the data that will be given on the printout as follows:

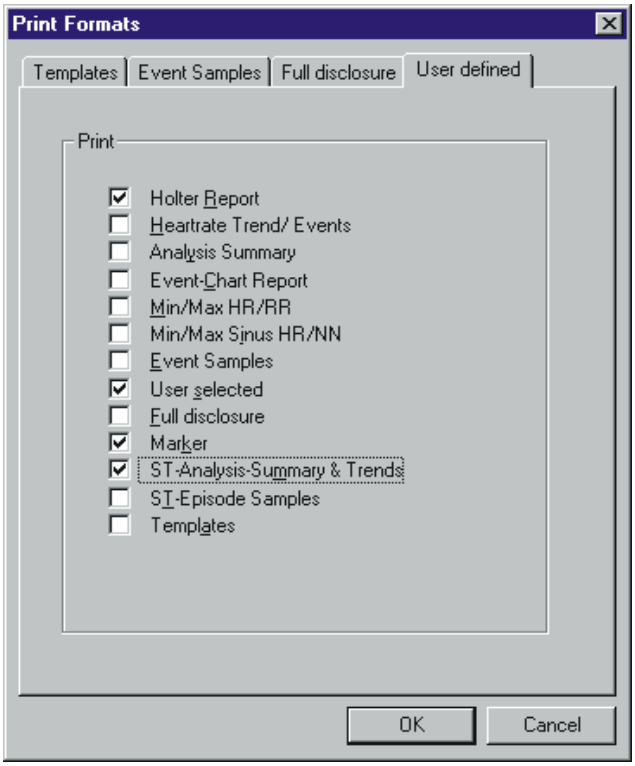
1. Click on the Print Preview icon **OR**

Select `print preview (user defined)` from the Patient menu:



The following screen is given.

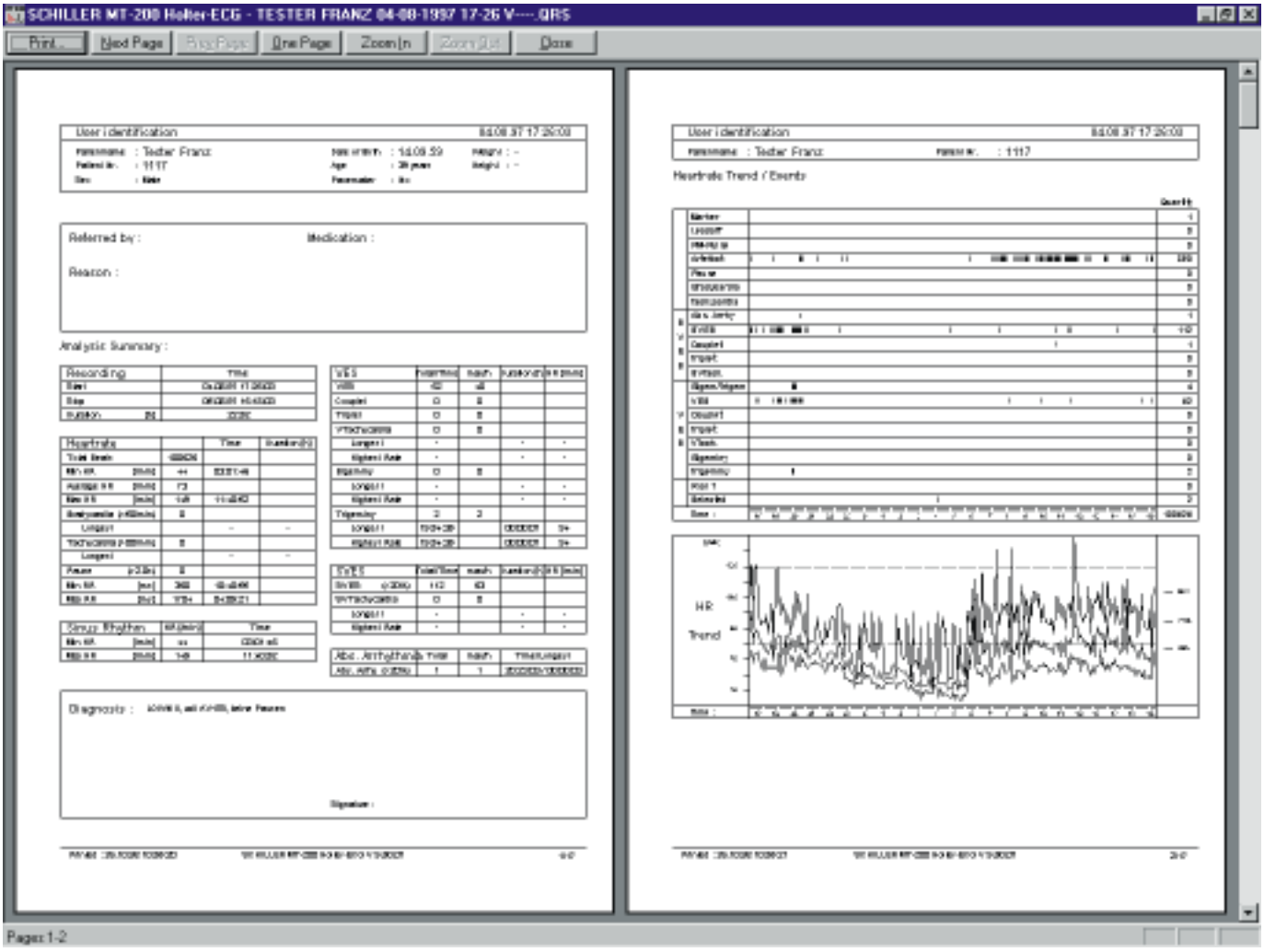
Note: Other print settings (rhythm events etc.) and data selection for print are available from this screen - see Section 4 -Print Formats



Printing

2. Check the boxes that you wish to print and click OK.

3. A page by page preview of the printout is displayed.



Click on the icons at the top of the page to:

Print	Proceed with printout as shown - *the printer settings are given in Section 4*
Next Page	Display next page
Previous Page	Display previous page
One Page / Two Page	Display one page or two consecutive pages
Zoom In	**Also click with left mouse button to zoom in or out**
Zoom Out	
Close	Do not print and return to ECG view.

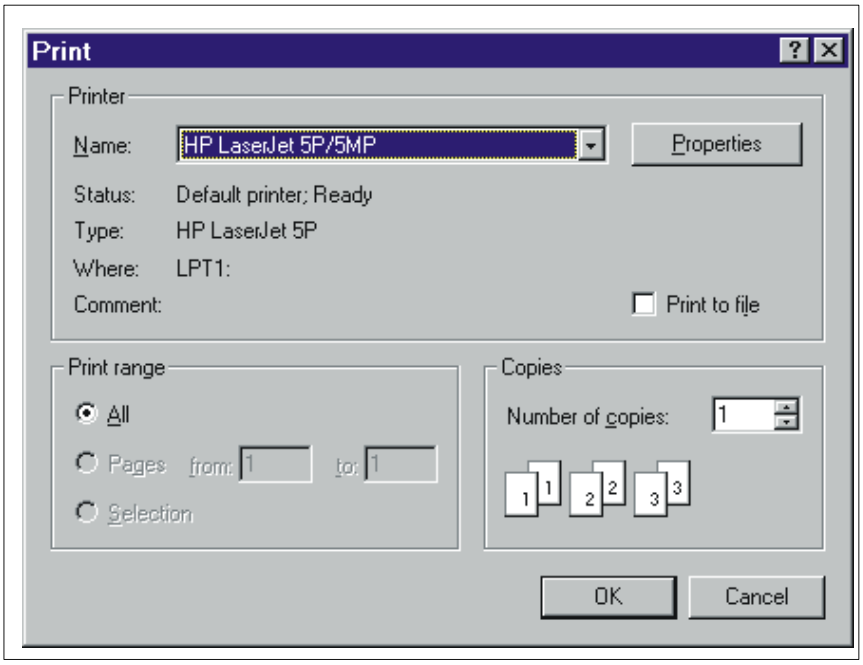
Printing

Obtaining a Printout

Note: Certain printer options, (text size, margins) are defined in Section 4 - Settings.

To obtain a printout of the displayed recording press the print icon in the main function icons at the top of the screen or select `print` from the display on the previous page

Note: The data that will be printed is user defined and can be preset or can be defined before every printout. If the option to define printout data before every printout is set, the data options will be displayed first (as shown on the previous page). See Section 4 for full details of all print settings.



Various hardware print setups can be defined. In normal use the printer that is defined and in use with your computer remains the same for the MT-200 program. However certain settings can be made in the MT-200 program for your preference. The printer can be selected here, and various layout options can be defined (paper size, Portrait/ landscape, print definition of graphics etc.). The various options are mostly self explanatory and are fully explained in the handbook for your computer or operating system.

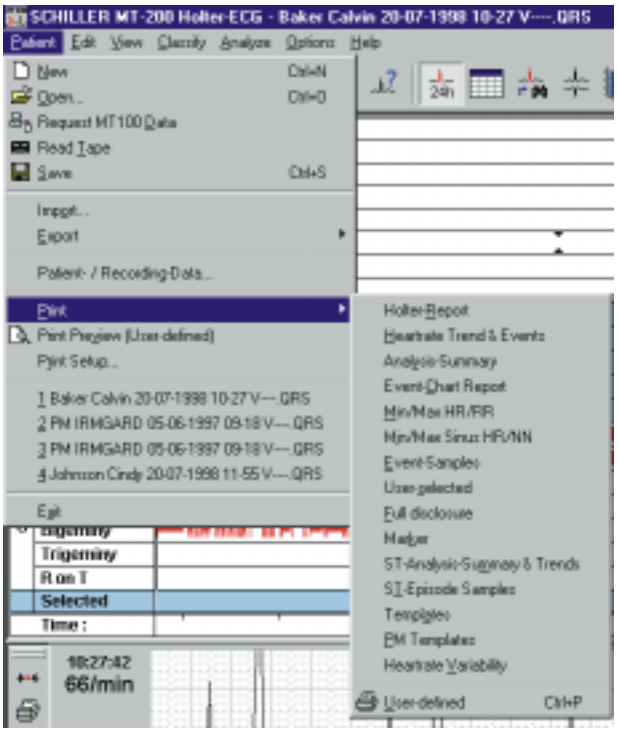
Define the number of copies, pages and printer.

If problems are experienced in printing open `print setup` to define the printer and other print settings.

Printing

Printing a Specific Page

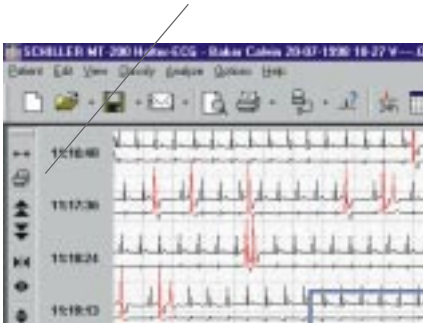
- **Select the required data that you wish to print in the print menu - *see Section 4 for details.***



The page selected is printed directly.

Printing a selected half hour ECG segment

- **In the ECG Rhythm View use the mouse to highlight an ECG segment. (Either the zoom view or the HR trend can be displayed below).**



Click on the print icon to the left of the ECG.

A half hour segment of the ECG recording is printed with the segment selected in the middle of the printed page i.e. approximately a 1/4 hour either side of the selected segment is printed.

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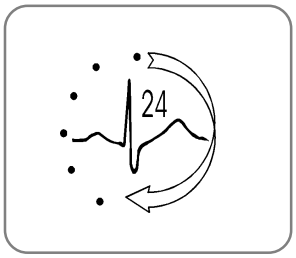
Holter Data Management and Analysis System



Section 3 - Miscellaneous Functions

Important Notes before using PDF or E-mail Functions

E-mail with Windows 95 or NT

If you require E-mail functions and your computer runs with Window 95 or NT operating system, windows messaging must be installed (with windows 98 or later, this is already installed). To install windows messaging you must have the original windows 95 or windows NT system disk. Proceed as follows:

- Access the windows messaging system installation program under C:/program files/windows 95 (or NT)/windows messaging
- Open the folder and run the installation program - you will be prompted to insert the system disk
- Follow screen instruction to install windows messaging

For sending e-mails in the MT-200 software, the internet explorer 4.0 must have the configuration `Standard SMTP E-mail Client` (see e.g. ´settings´ in Outlook Express; start the PC again after setting).

PDF files with Acrobat Reader

The MT-200 PDF function will only work with Acrobat reader version 4.0 or later. This is available on the Schiller software CD and must be installed before PDF files can be generated or viewed. If an earlier version of Acrobat is installed on your computer, it must first be uninstalled before installing V4.0. To do this proceed as follows:

- Access windows uninstall program under /desktop/my computer/control panel/ > add/ remove programs.
- When selected, a list of all installed programs is displayed - select Acrobat and click the add/remove icon. You will be prompted to confirm deletion.
- When the old version has been uninstalled, the new version can be installed from the Schiller CD ROM in different languages.

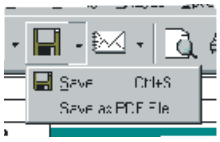
Editing PDF Files

PDF files generated with the MT-200 program can be edited with Adobe Acrobat (version 4.0). To do this, the PDF files must be opened in Adobe Acrobat itself and then closed before opening the MT-200 program. This is a known problem also with other software applications and Adobe Acrobat: if Adobe Acrobat is opened when using the MT-200 software, it is not possible to open the PDF files in the MT-200 software.

Miscellaneous Functions

Saving a Recording in Original or PDF format

Recordings can be saved in original or PDF format. The advantage of PDF format is that it is compressed and therefore the stored recordings take significantly less space on the harddisk than normally stored recordings.



Three methods are available to store a recording as follows:

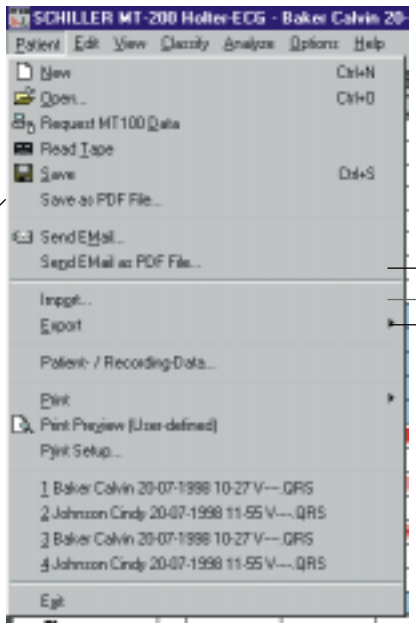
1. **With the mouse click on the Save icon**

   Clicking on the icon itself saves the recording in original format. Clicking on the arrow to the right gives you the option to save as original or as a PDF file.

2. **Hold the Control key pressed and press the `S` key on your keyboard.**

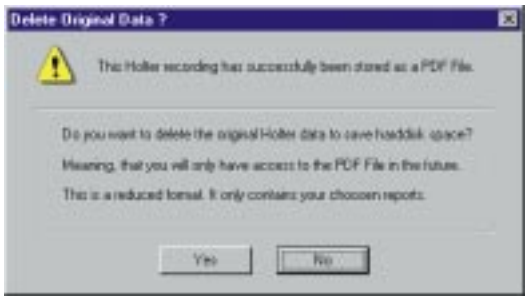
   This saves the files in original format

3. **Open the `Patient` menu with the mouse and save as original or PDF format.**



When a recording is saved as PDF format you are prompted to save selected data.

The Adobe Acrobat reader program is entered automatically and the pdf file generated. You are then prompted to save or discard the original file.



Miscellaneous Functions

Sending a Recording by E-mail

Recordings can be sent over the www by e-mail in original or PDF format. The advantage of the compressed PDF format is that it takes less time to send than uncompressed recordings. Only the currently displayed recording can be sent by e-mail. To send the recording select the option from the patient menu. You are then prompted to enter the recipients address. Click OK to send.

Importing Recordings

Recordings can be imported from floppy disk, CDROM, and network drives, etc.,. Select the import option from the 'patient' menu.

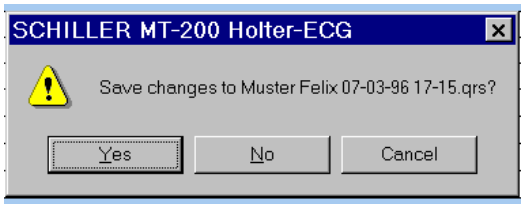
Exporting Recordings

Recordings can be exported to floppy disk, writable CDROM, local drive, and network drives, etc.,. Select the export option from the 'patient' menu. The option to export 'current recording', 'not yet exported recordings' or 'selected recordings is given. When one of these is selected it is exported to the drive and directory defined in system settings > directories. (See Settings section).

Exiting the Program

To exit the MT-200 program select `Exit` from the patient menu (see previous page).

If the currently displayed recording has been reanalyzed since the last save you are prompted if you want to save to the current analysis parameters:



Select YES to overwrite recording with current analysis parameters, NO to save recording unchanged, or CANCEL to return to the program.

Note: All recordings are automatically saved after they have been downloaded from the Holter recorder.

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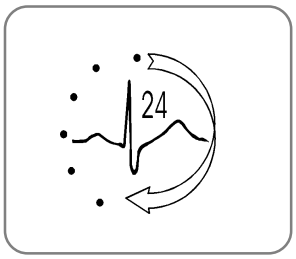


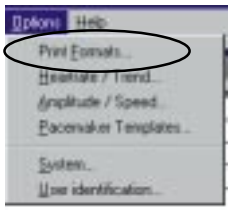
Section 4 - System Settings and Options

Print Formats

In the `print formats` menu you can define the default information that you wish to have printed. This means that the information defined here is remembered when the program is next opened.

The print format defined can of course be manually overridden and individually defined before every printout when required.

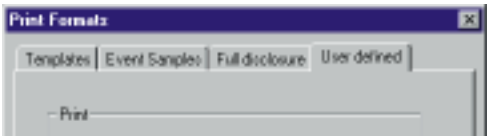
To set the default select `Print Formats` in the OPTION menu at the top of the screen.



Options are given at the top of the Print Formats screen as follows:

Templates Select the template classes

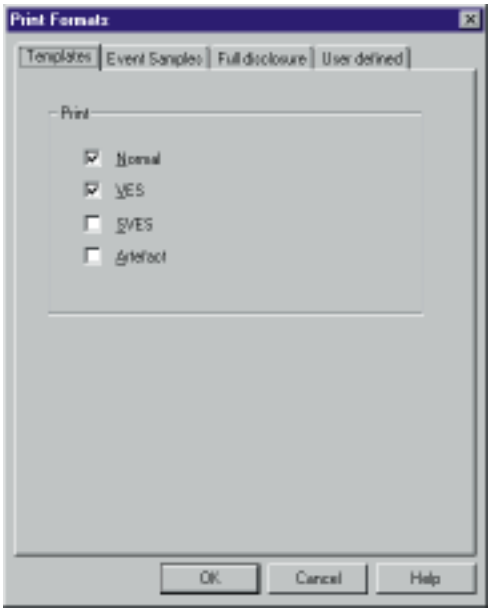
Event Samples The event sample screen allows you to select specific events for printing.



Full Disclosure The full disclosure screen allows you to select specific time segments of the ECG recording for printing.

Note: specific time segments are individual to a recording and thus cannot be remembered as a default.

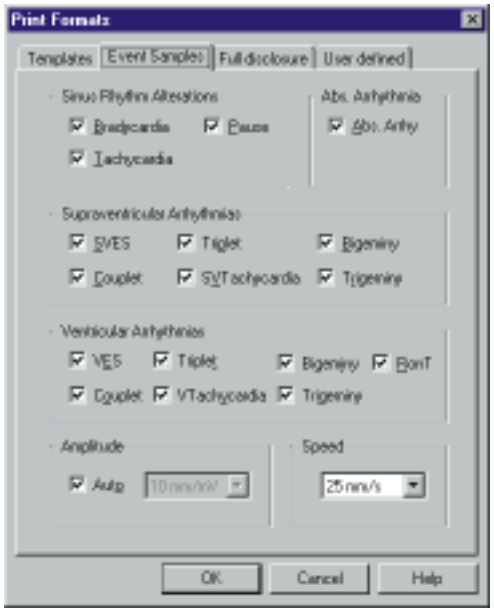
User Defined The user defined screen allows you to define the categories of data for printing

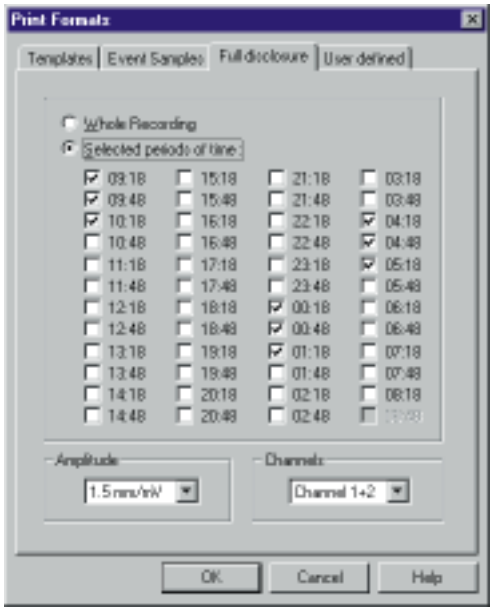


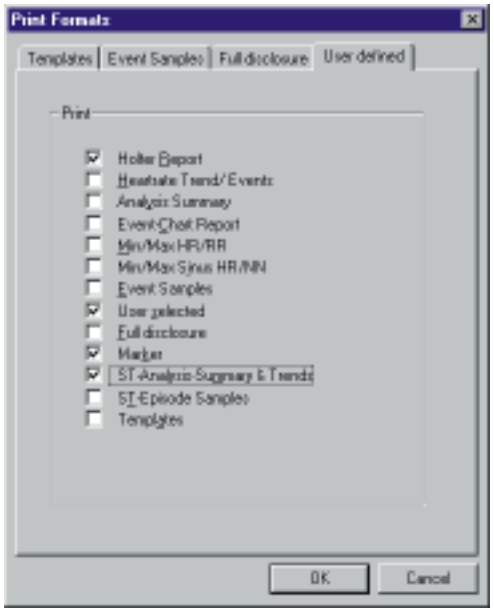
Clicking on one of these print format options gives the displays and settings as described in the following pages.

Templates

When the Template tab is clicked the following options are given. Select the required template classes to be printed.







Print Formats

Event Samples

In this screen event categories are defined for sample event printing.

Three event samples are printed for each category selected. In a complete 24 hour recording, the first event detected in each of the three 8-hour segments, is printed.

The sample events are only printed when the `event samples` box is checked in the User Defined screen (see later).

Check the relevant boxes. The amplitude and speed refer to the print size. If `auto` is selected for amplitude, the program automatically selects the optimal size for the signal strength.

Click OK to set the events, click cancel to leave settings as previously defined.

Full Disclosure

In this screen the ECG time segment(s) that is (are) printed when the `full disclosure` box is checked in the User Defined screen (next page) is set.

Here you can select to print the complete 24 hour recording or select half hour segments of the recording. When the `selected periods of time` box is checked, the half hour segments can be selected.

Note: The time of the recording and the half hour segments apply to the current ECG recording. When a recording is not displayed, time segments cannot be selected.

User Defined

In this screen the data sections to be printed are defined.

Note: In addition to the defined data, a `header` is given on every printed page to enable every page to be readily identified. The header gives the following information:

- User Identification - entered in the options menu
- Date and time of the recording
- Patient name and number

Print Formats

Holter Report

This gives a statistical overview of the recording and includes:

- Name, sex, number, Date of Birth, age, height and weight of the patient.
- Start/Stop time and duration of the recording
- Heart rate average, maximum, minimum rate with occurring time, total number of beats, number of, and maximum with occurring time of Bradycardia, tachycardia and pause events, minimum and maximum RR time and time of occurrence
- Time of recording for maximum and minimum heart rate Sinus rhythm
- Number of SVES (SV tachycardia) total and maximum number in one hour and other statistical data - longest, highest rate, duration etc.
- Number of VES (couplet, triplet, V tachycardia, bigeminy, trigeminy) total and maximum number in one hour and other statistical data - longest, highest rate, duration etc.
- Manually entered diagnosis and assignment information.

Heart Trend / Events

This page gives:

- The heartrate trend over the entire recording giving the max, min and average heart rate.
- A table giving all events detected over the entire recording in relation to time.

Analysis Summary

Statistical overview for every hour of the recording for:

- Heart rate - total number of beats, min/max rate, number of tachycardias, bradycardias and pauses
- supraventricular arrhythmias - number of - couplets, triplets, SV Tach, Bigem and trigem
- ventricular arrhythmias - number of - couplets, triplets, SV Tach, Bigem and trigem
- lead off/artifacts

Event Chart Report

Graphical view for all event categories giving the number of events in every hour of the recording.

Min / Max HR/RR

Zoom views of the minimum and maximum heart rates measured in the recording, Zoom views of the minimum and maximum RR interval measured in the record

Event Samples

Sample zoom views of selected events and the time at which they occurred are printed. For each event category three zoom views are printed. That is the first event detected in each 8 hour section. A graphical overview of the number of events for every category selected is also given.

As many or as few event categories can be printed as required as defined in Event samples (see previous pages)

Print Formats

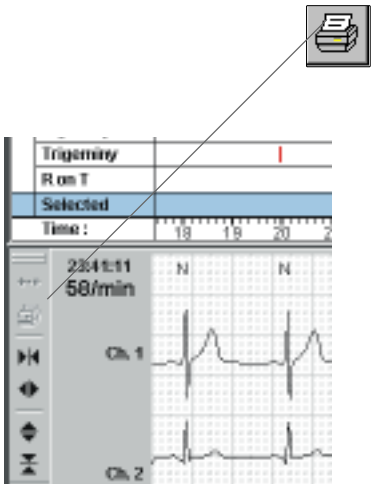
User Selected

Zoom print of a section of the recording that has been selected by the user.

The user selection is made:

° in the edit menu - `select user sample` or

° in the zoom view position the cursor on the desired complex and click on the print select icon. `Selected` is displayed on the zoom view icon. To deselect a user sample position the cursor on the selected complex and again press the print icon.



Full Disclosure

Printout of the complete recording or of selected 30 minute sections as defined in `full disclosure` (see previous pages). One page per half hour.

ST Analysis and Trend

Check this box to print:

° Measurement table of all ST episodes

° The ST trend of amplitude and slope over the entire recording for channel 1 and channel 2.

° The heart rate trend over the entire recording giving the max, min and average heart rate.

ST Episode Samples

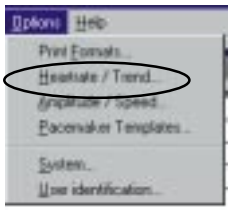
Sample zoom views of ST episodes and the time at which they occurred are printed. The four ST episodes with the highest recorded ST levels are given (with the highest recorded ST level printed first). Each ST episode zoom view gives the maximum level reached during the ST episode, and the slope, the heart rate and the time of occurrence.

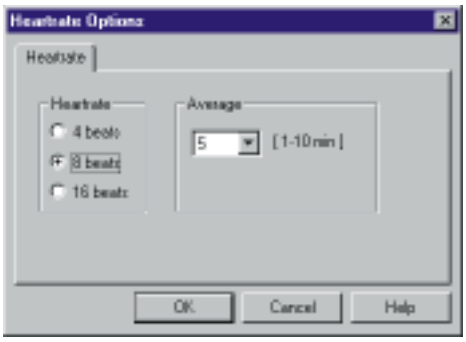
Marker

Prints all manual markers (set during the recording when the patient presses the event button on the MT-100).

Heart Rate Trend

The heart rate is calculated over 4, 8 or 16 beats and averaged over 1, 2, 5 or 10 minutes. Select `Heartrate / Trend` in the `Options` menu at the top of the screen.





Click on the required option.

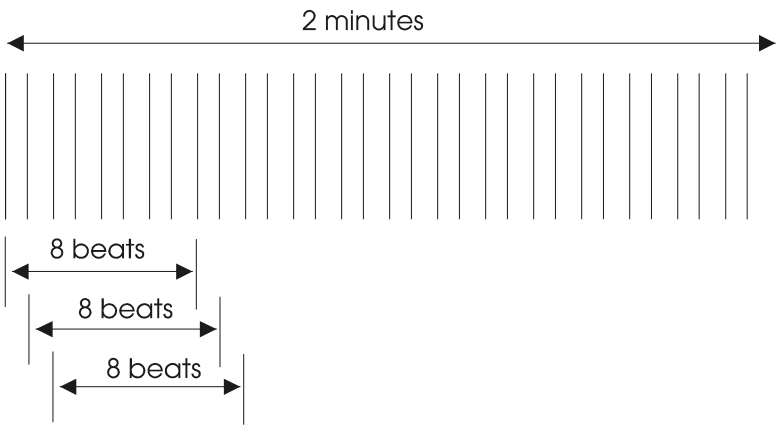
Click OK to confirm, or Cancel to keep the current settings.

When you exit this screen heart rate is calculated on the option selected.

The Heart rate is calculated as follows:

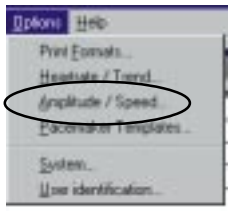
- Individual heart rates are calculated (as beats /minute) over either 4, 8 or 16 contiguous continuously averaged heart beats as shown on the example below.
- The highest and lowest heart rates given in the HR trend diagram are given as the highest and lowest heart rate measured over 1, 2, 5, or 10 minutes.
- The average heart rate is given as the average heart rate calculated from the individual heart rates measured (as above) over the 1, 2, 5, or 10 minutes selected.

Example: Heart rate setting is 8; average setting is 2 (minutes)



Etc. For two minutes

Amplitude/Speed



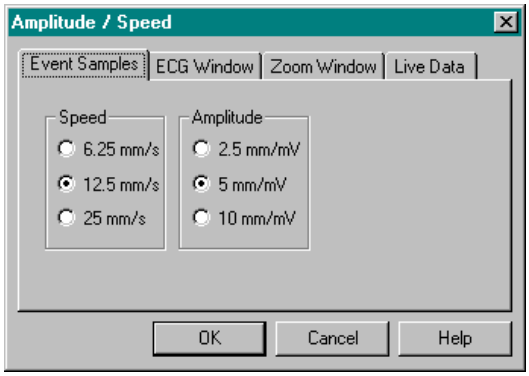
Note: The amplitude and speed scales are remembered when the MT-200 program is shut down. This means that when opening the MT-200 program, the amplitude and speed scales are the same as those set when the program was last closed.

The size and speed of the ECG recording can be set in the options menu:

Select the Amplitude /Speed option and press ENTER or click with the left mouse button.

At the top of the screen are four icons which select sub screens for data entry as follows.

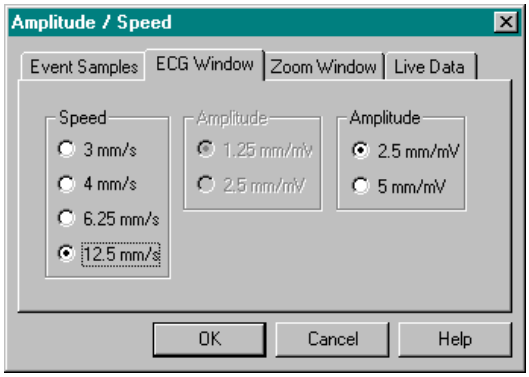
Event Samples



This sets the default size and speed of the traces in the event samples window. Three different speeds and three different amplitudes are available.

Click OK to confirm, or Cancel to keep the current settings.

ECG Window

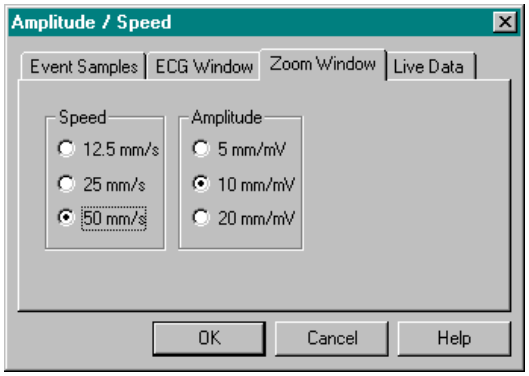


Amplitude/Speed

This refers to the ECG View recording window. Four different speeds and four different amplitudes are available. Note that the larger two amplitudes (2.5 & 5mm/mV) can only be set when the one of the two higher speeds are set (i.e. 6.25 or 12.5 mm/s) and similarly, the smaller two amplitudes (1.25 and 2.5 mm/mV)) can only be set when the one of the two slower speeds are checked.

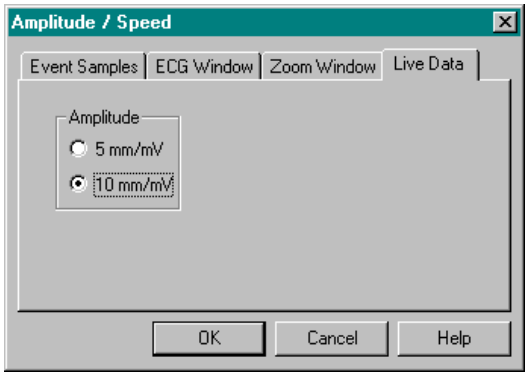
Click OK to confirm, or Cancel to keep the current settings.

Zoom Window



This sets the zoom view default size. Click on the speed and amplitude that you wish and click OK to confirm, or Cancel to keep the current settings.

Live data



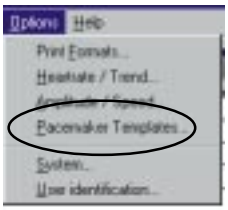
This refers to the monitor screen displayed when the Holter unit is connected to the PC before commencing a 24 hour recording. Only two amplitudes can be set.

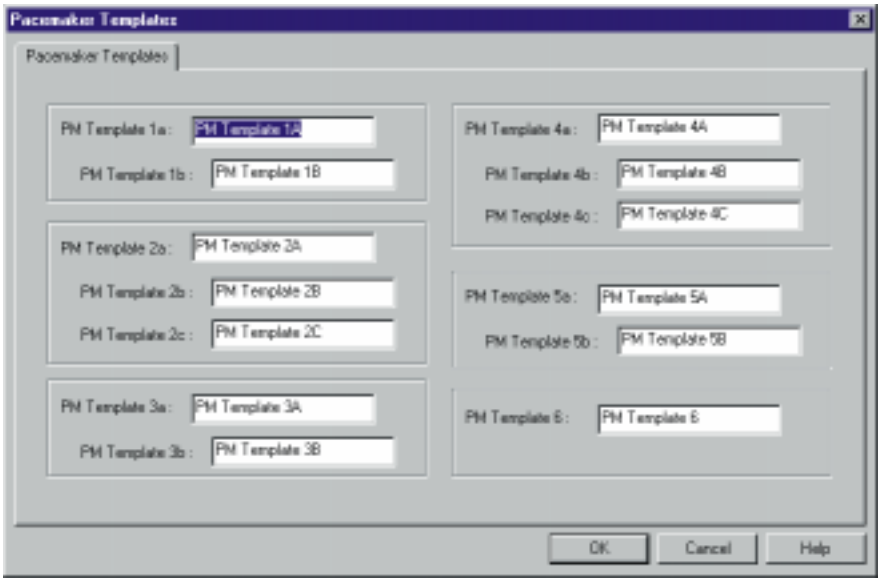
Click OK to confirm, or Cancel to keep the current settings.

Note: The amplitude and speed can also be set with the tool icons on the right side of the screen.

Pacemaker Settings

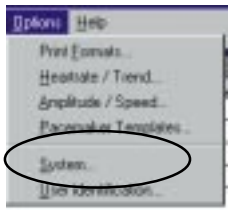
Here the user can define more meaningful individual names to the pacemaker templates in place of the defaults. For example you may wish that PM template 1A becomes DDD pacemaker template or that template 3 becomes Sensing defect.



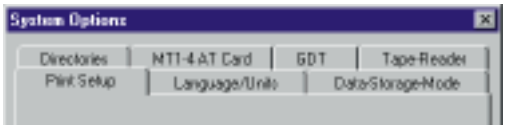


System Settings

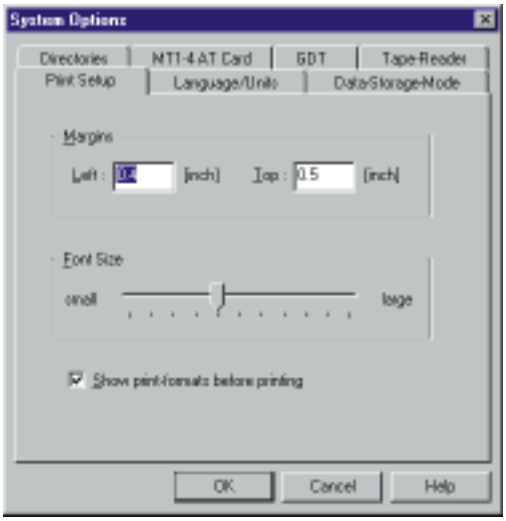
Access the system options by clicking on `System` in the Options menu



System setting option pages are given at the top of the system options screen as follows:



Clicking on these system options gives the displays and settings described in the following pages.



Print Setup

Also see Print Formats

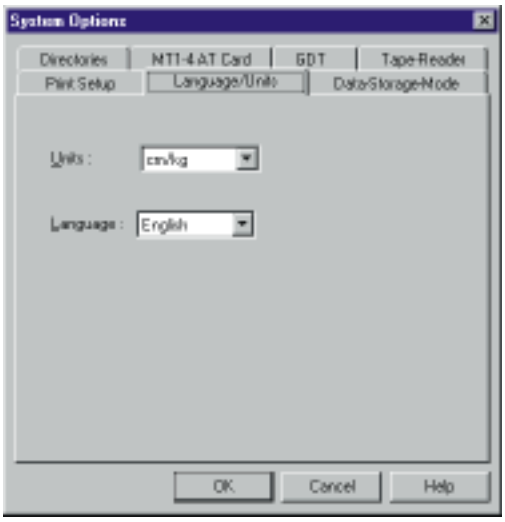
Print Setup gives the following options:

Margins Here the print borders can be defined. Define the free space between the top of the page and the top of the printing, and between the left margin of the page, and the left margin of the printing.

Font Size Set to your preference. The actual print size depends on your printer and some experiment may be necessary to determine your preference. Note that the font size defined here does not affect the size of the data printout.

Show Print formats Check this box to display the data categories that can be printed **before printing**. When this box is checked, the user can define the data groups to be printed before every print
.
Click OK to confirm, or Cancel to keep the current settings.

System Settings



Units & Language

Use the unit screen to define the units that you wish to use in the program for patient data and the language for the printout and program.

Units Select between cm/kg or ins/lbs.

Language Select the language of your choice

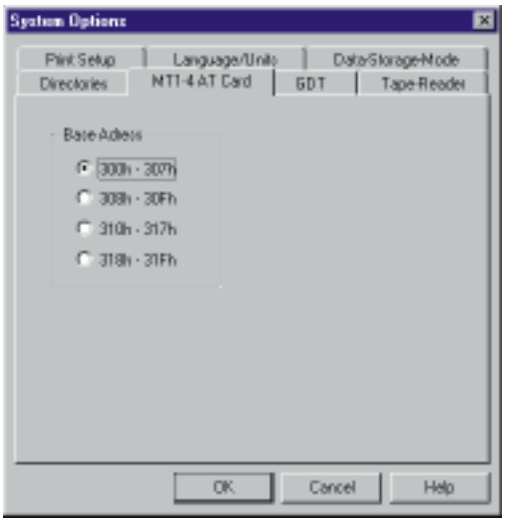
Click OK to confirm, or Cancel to keep the current settings.

Directories

Use the directories screen to define the default directory where you wish to store recordings and export recordings. You can of course select CD ROM or other storage medium if you have them. Enter the directory screen as follows:

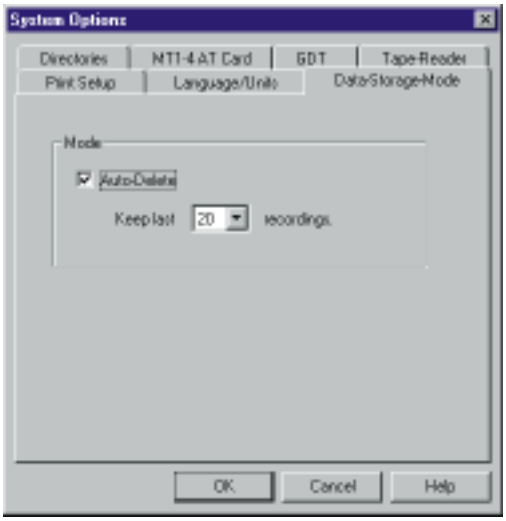
Enter the new directory route.

Click OK to confirm, or Cancel to keep the current settings.



MT 1-4 AT Card Address

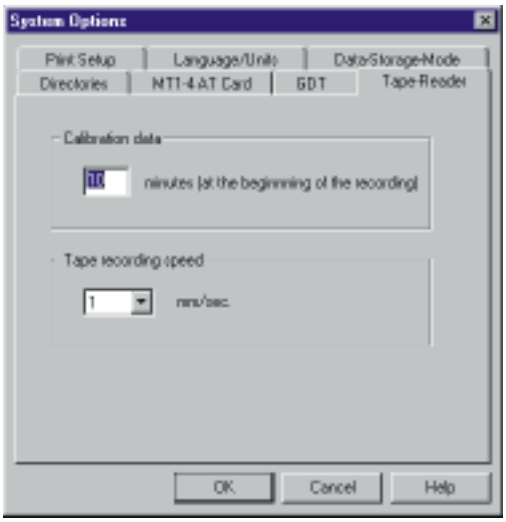
The address of the AT card is defined on installation (see Section 5). Use this screen to check the setting and redefine if necessary.



Data Storage Mode (Auto Delete)

A complete 24 hour recording requires approximately 8 Mbytes of storage space which is stored automatically after downloading from the Holter recorder. This means that your hard disk can quickly fill if recordings are not deleted when they are no longer required. The auto delete function allows recordings to be automatically deleted. The auto delete function can be set between 5 and 100 recordings. This means that when the auto delete box is checked, only the latest 5, 10, etc., recordings up to 100 will be stored on your computer. When this number is reached and a new recording made, this latest recording is stored and the oldest recording stored is automatically deleted.

Check the `Auto delete` box and select the number of recordings that you wish to have stored on your system before overwriting.



When the `Auto Delete` box is not checked, the auto delete function is not active and all recordings are stored

Tape Storage Mode

This removes the calibration data at the beginning of the tape which every tape machine requires. A value must be entered (cannot be set to `0`). The length of the calibration data is different for every machine and the value will be found in the handbook for the tape machine.

In some instances a 48 hour recording can be made with a 120 minute set at 1mm/sec. Please note however that when this is downloaded to the MT-200 ***only the first 24 hours can be stored and analyzed.***

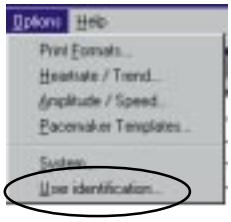
Note: The SCHILLER system uses the Braemar tape reader SYS350. This tape reader was designed for the US medical industry Holter standard AAMI EC38 and the European standard IEC-601-2-47. Therefore the tape reader is not designed for tapes which have been recorded as phase or frequency modulated data.

GDT

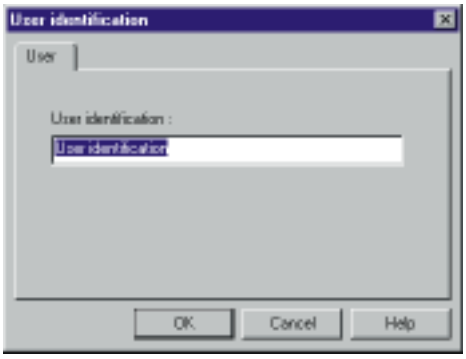
Use the GDT screen to define the default directory where you wish to store recordings and export recordings when in a GDT network. Check the GDT Directory box - The GDT directory and abbreviations can be entered

Click OK to confirm, or Cancel to keep the current settings.

User Identification



The user identification entered here is printed at the top of every page. This can be the consultant, operator or department etc. Enter the user identification entry field from the options menu:



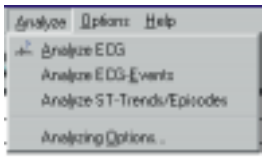
Select `User Identification`. The following is displayed:

Enter the user identification that you wish.

Click OK to confirm, or Cancel to keep the current settings.

Analysis Measurement Options

The analyze options are given in the analyze menu:



Analyze ECG Select this option to analyze a new recording or to reanalyze the current file after changing any settings. The icon performs the same function.

Analyze ECG Events Select this option to recalculate the event information (apart from VES events), after changing any settings.

Analyze ST Trends/ Episodes Select this option to recalculate the ST trend and episodes, after changing any settings.

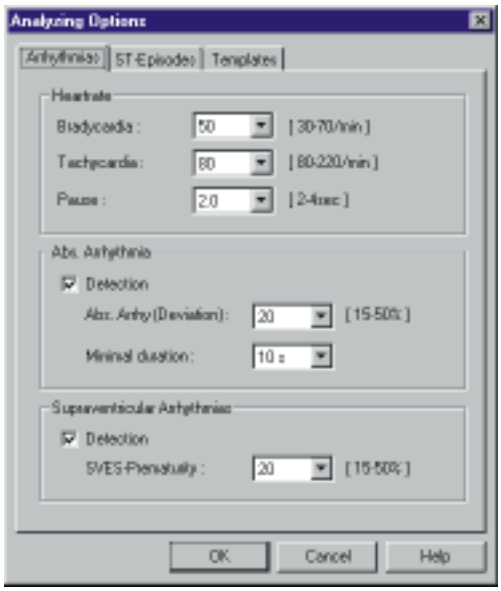
Analysis Options

This gives the calculation options that are applied for a recording when analyzed. When a setting has been changed, the revised calculation setting can be applied to the recording that is currently displayed (select `analyze ECG` to reanalyze the complete recording or `analyze ECG events/ analyze ST trends` to analyze a section of the recording - see above).

Settings are given for arrhythmia analyze options, ST Episodes and for the number of VES templates that will be generated.

Arrhythmia

The arrhythmia analysis options are as follows:



Heartrate Define the heart rate below which the program will make a classification of Bradycardia and above which the program will make a classification of Tachycardia.

Define the time interval above which the program will make a classification of Pause.

Analysis Measurement Options

IMPORTANT:	*When absolute arrhythmia detection and supraventricular detection is required the percentage setting must be the same for both.*

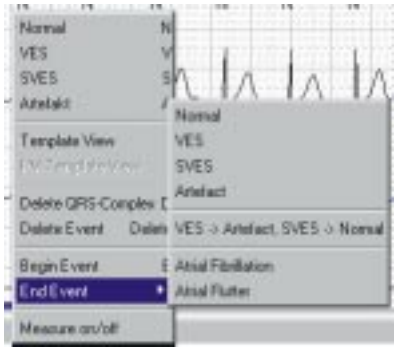
Abs. Arrhythmia — **Absolute arrhythmia** detection can be enabled by checking the box or disabled (box unchecked). The percentage difference at which an absolute arrhythmia is defined is set between 20 and 50%.

Minimum Duration — The time duration above which absolute arrhythmia will be classified.

CAUTION:	*If an Absolute Arrhythmia is detected from the analysis software then this could be an indication of atrial flutter or atrial fibrillation.*

Supraventricular Arrhythmia — Supraventricular arrhythmia detection is enabled when the box is checked. The percentage difference at which a supraventricular arrhythmia is defined is set between 20 and 50%.

Absolute Arrhythmias can be defined as atrial flutter or atrial fibrillation as follows. Events can also be deleted at any time:

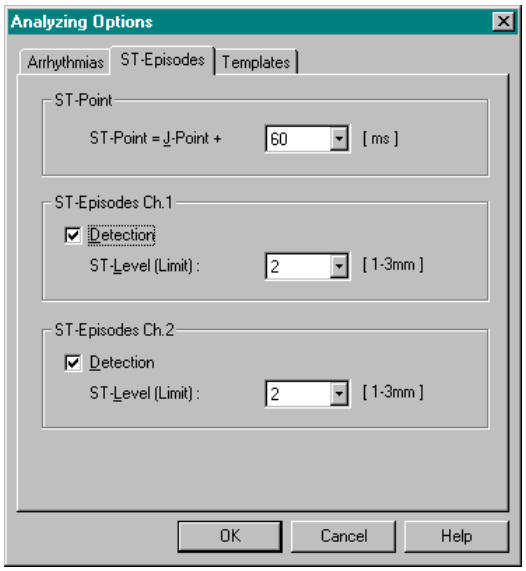


- **Enter the ECG view and in zoom view click the right mouse button and select `begin event` at the beginning of the arrhythmia**
- **Go to the position in the recording where the arrhythmia ends**
- **In the zoom view click the right mouse button and select `end event`. A number of classification options are available. Select `Atrial flutter` or `atrial fibrillation` as required.**
- **Select `Delete Event` to delete the event.**

Analysis Measurement Options

ST Episode Analysis Options

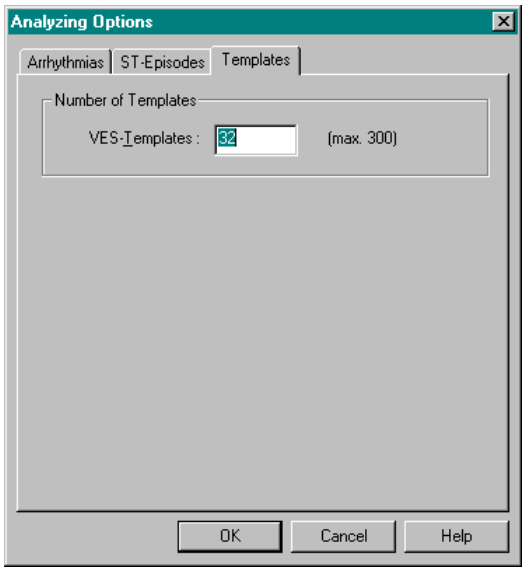
The ST episode analysis options are as follows:



Both the ST point and the ST level can be set. The ST level can be defined separately for channel 1 and for channel 2.

Note: In the MT-200 analysis software, the J-point is located 56ms after the trigger point (the point in the QRS complex at which the slope is greatest). The ST point is located `x` ms after the J-point, where `x` is selected between 10 ms and 100 ms (see above). Thus, when the heart rate changes significantly, correct values of ST-segment shifts can only be obtained with an adaptation of the ST measurement point (the higher the heart rate, the closer the ST point).

Click OK to confirm, or Cancel to keep the current settings.

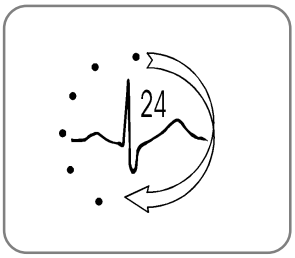


Template

The number of templates to be defined are set in the templates option:

MT-100/MT-200

Holter Data Management and Analysis System



Section 5 - Installation

Installation/System Requirements

Note: This section is only applicable for initial installation. If the program is already installed in your computer, go directly to Section 1.

To install the MT-200 program you must have the following:

- PC compatible computer (166Mhz or greater) with 32 MB RAM
- Hard Disk Space - 500Mbyte of free disk space
- Graphics - XVGA 1 MB with 1024 x 768 Resolution or better
- Industry standard slot (16 bit ISA expansion slot) for the plug in of the AT card MT 1-4
- Windows 95 or later operating system installed

The MT-200 Program package comprises the following:

- MT-200 CDROM
- Dedicated MT-200 special AT card (MT 1-4 AT Card - with opto link)
- Hard lock key - the hard lock must be connected to the parallel port for the program to work
- Special Optical link cable (MT-100 Holter unit /PC)

Installation of MT-200 General Network License

The general license enables full use of the program. Installation of the MT-200 program without the license number will be a demo version only.

Installation of MT-200 licenses are possible under Windows 95, Windows 98 or Windows NT for MT-200 software version 1.52 (and higher); a correct installation requires an installed Internet Explorer version 4.0 (and higher).

First install the MT-200 software as usual (on each PC). After this install the MT-200 General License on each PC of the network, from the special General License disk .

The General License number is given in the menu ´Help´ under ´About MT-200´. The General License number is also given on the bottom of each page of the preview and of the printout.

Installation/System Requirements

Unpacking

SEE ENCLOSED SOFTWARE LICENSE AGREEMENT. BY BREAKING THE SEAL OF THE PACKAGE YOU ARE AGREEING TO BE BOUND BY THE TERMS OF THE AGREEMENT.

Note The card, CD ROM and hard lock key are packed in antistatic material for protection during shipment. When handling the card, avoid damaging the static sensitive components on the board by reducing any static electricity on your body. Before handling the card:

- touch the metal chassis of your computer to reduce body static
- maintain grounding by wearing a wrist strap attached to the chassis.

1. **Gently take the card out of its box.**
2. **Remove antistatic pouch.**
3. **Return all packing material to the shipping container and store in a safe place.**

   Always use the original packing if you need to return any item to Welch Allyn Otherwise the warranty is void.

4. **Check all items for signs of any visible damage.**

   Immediately inform your dealer if you find that any item is damaged.

Installing the AT Board

Communication and data transfer between the MT-100 Holter recorder and the PC is via a special nonconducting optical cable. The purpose of the AT card (MT 1-4) is to provide the connector for the optical cable and to control the data transmission protocol between the Holter recorder and the PC. The AT board is a standard size card for easy installation in an existing card slot in your PC.

Every hardware device (including printed circuit boards) installed in your computer has an `address` to enable the computer to find the device when needed. Every device must have a different address otherwise problems can occur with the computer. Four different addresses can be set for the AT card and are defined by small switches on the card itself. The addresses available are:

- 300h - 307h (this is the factory set default address)
- 308h - 30Fh
- 310h - 317h
- 318h - 31Fh

Before setting the address on the card and installing the card, existing addresses on your computer must be checked because it is possible that one of the addresses is already in use by another device.

Note: If you are not familiar with PC working or have problems with the terminology we recommend that you consult a PC consultant or your local WELCH ALLYN agent.

Setting the Card Address

First check the allocated addresses on your computer:

1. **Using the mouse, select and double click with the left button on the <My Computer> icon.**

Further icons (or menu items) are displayed.

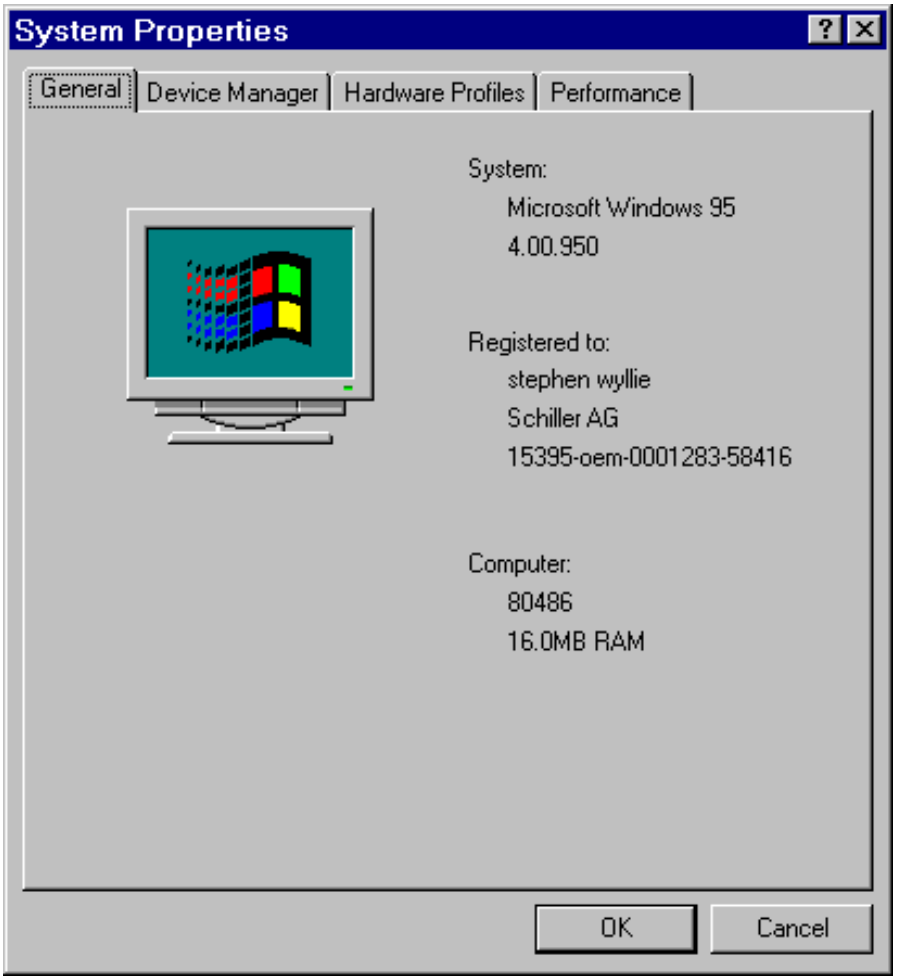
Installing the AT Board

2. Using the mouse, select and double click with the left button on the <Control Panel> icon.

Further icons (or menu items) are displayed.

3. Using the mouse, select and double click with the left button on the <System> icon.

The following screen is displayed:



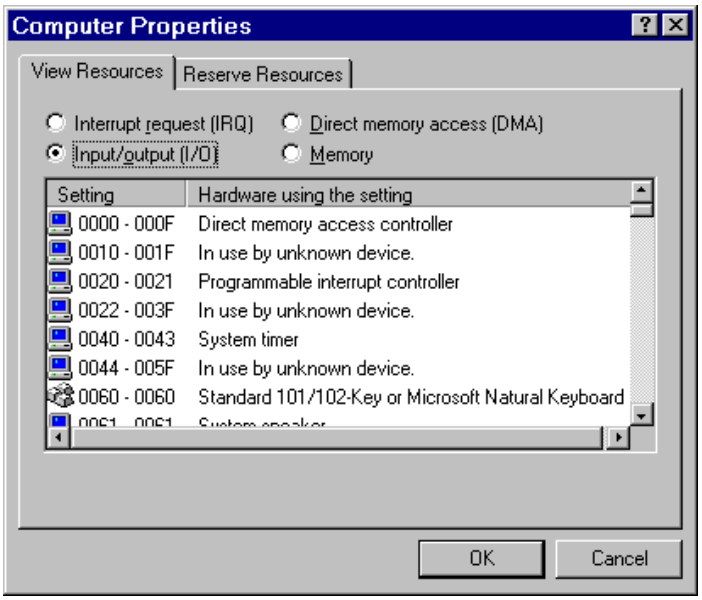
4. Click on <Device Manager>

The following is displayed:

Installing the AT Board

5. Click on `properties`

The following is displayed:



If this screen is not displayed check the <input/output(I/O)> box

A list of all the allocated addresses is given under the title `Setting`. If the default on the AT card (300h - 307h) has been allocated, set the DIP switches as detailed on the following page, to one of the other three possible addresses.

The address that is set on the board must be entered in the MT-200 program when initially installed. Note the address allocated.

Installing the AT Board

CAUTION: THE AT CARD CONTAINS STATIC SENSITIVE DEVICES - OBSERVE ANTI STATIC PRECAUTIONS WHEN HANDLING

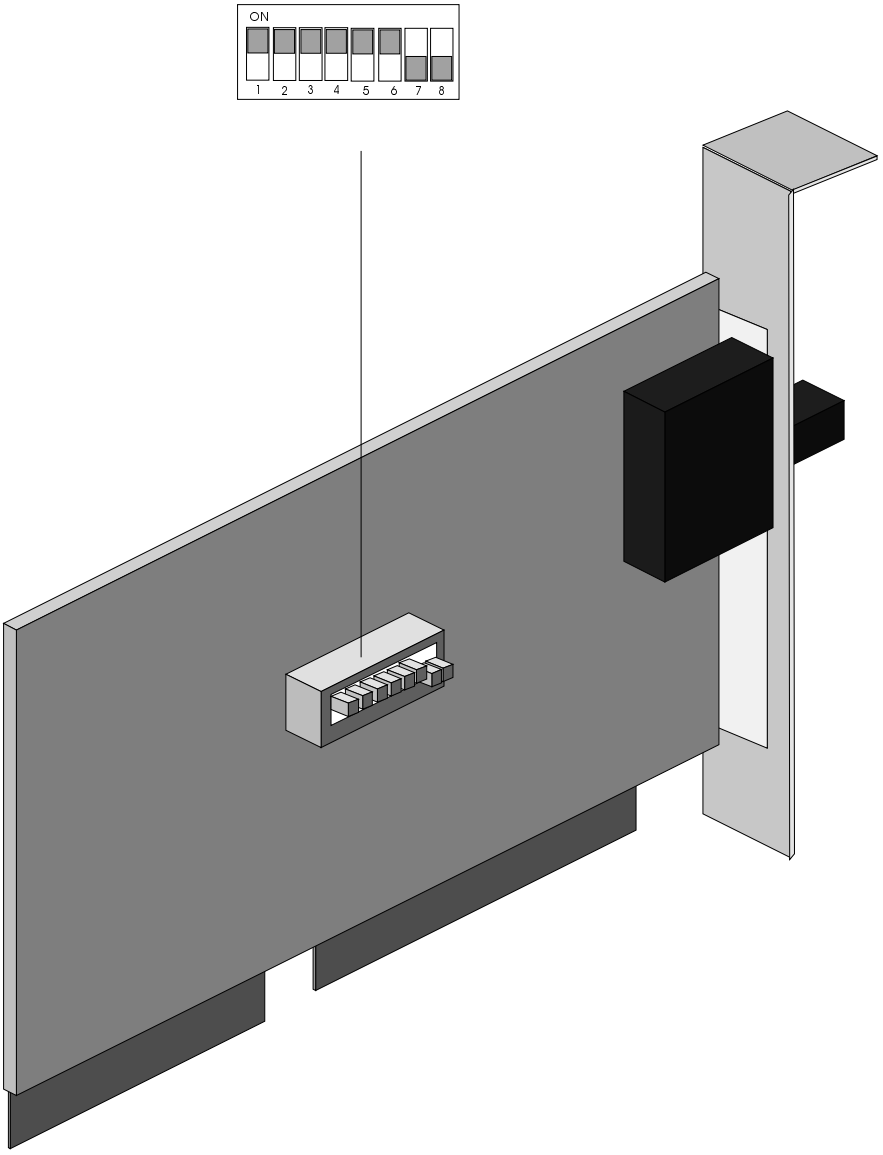
6. Set the DIP switch setting on the AT card for the correct address. Four address settings are available as follows:

DIP Switch Setting								
1	2	3	4	5	6	7	8	**Address**
X	ON	ON	ON	ON	ON	OFF	OFF	300h - 307h (DEFAULT)
X	OFF	ON	ON	ON	ON	OFF	OFF	308h - 30Fh
X	ON	OFF	ON	ON	ON	OFF	OFF	310h - 317h
X	OFF	OFF	ON	ON	ON	OFF	OFF	318h - 31Fh

X = Any position

The address must be the same in the MT-200 program as that set on the board. The default of the MT-200 program is the same as on the board (300h-307h). If the address is changed on the board the address must be changed in the program. This is carried out when installing the software.

Installing the AT Board



Address shown is the default (300h - 307h)

Installing the AT Board

Note: All PCs are different and these instructions give a overview of card installation only. Please consult the handbook supplied with your PC.

1. **Ensure that your PC is switched off and disconnect the mains cable. Disconnect power to all attached peripherals.**

2. **Remove all cables connected to the computer.**

3. **Turn the computer around so that the back is facing you. Remove the cover of the PC. If you are unsure of the screws to remove consult the manual for your PC.**

4. **Select any vacant 16 bit ISA expansion slot and remove the blanking plate as described in the handbook for your PC.**

5. **Take the card and position it in the slot. Firmly push into socket.**

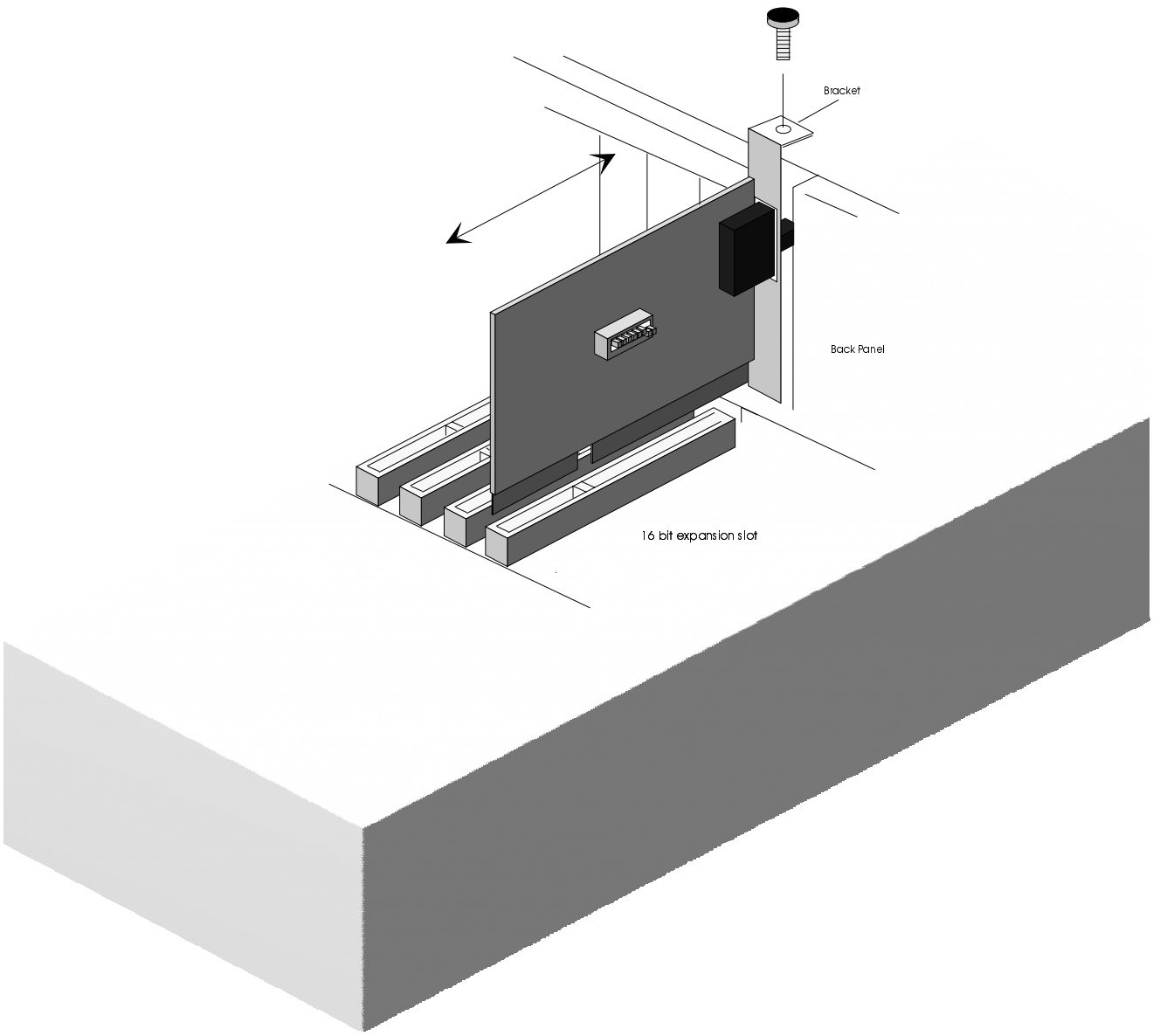
DO NOT FORCE THE CARD IN THE SLOT OR WIGGLE IT FROM SIDE TO SIDE. FORCING IT WILL PUT UNNECESSARY STRESS ON THE ADAPTER AND MAY DAMAGE THE SLOT

6. **Secure the card.**

7. **Replace PC cover**

8. **Replace all cable assemblies**

Installing the AT Board



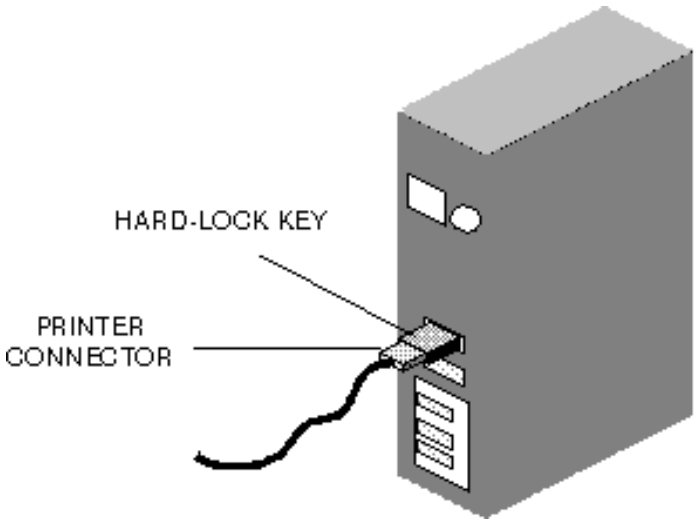
Installing the Program

The hard-lock key is a plug which contains a code to enable the MT-200 program to be used. It is connected to the parallel port of your computer. The hard-lock key can be inserted at any time but we recommend that it is positioned before installing the program.

Procedure

° **Before switching your computer on, insert the hard-lock in the parallel port on the back of your computer**

Note: The parallel port is usually the printer connection. If your printer is connected to this plug, first remove the printer connector, insert the hard-lock key, and reconnect the printer to the hard-lock key. That is the hard lock key is inserted in the parallel port between the computer and the printer connector.



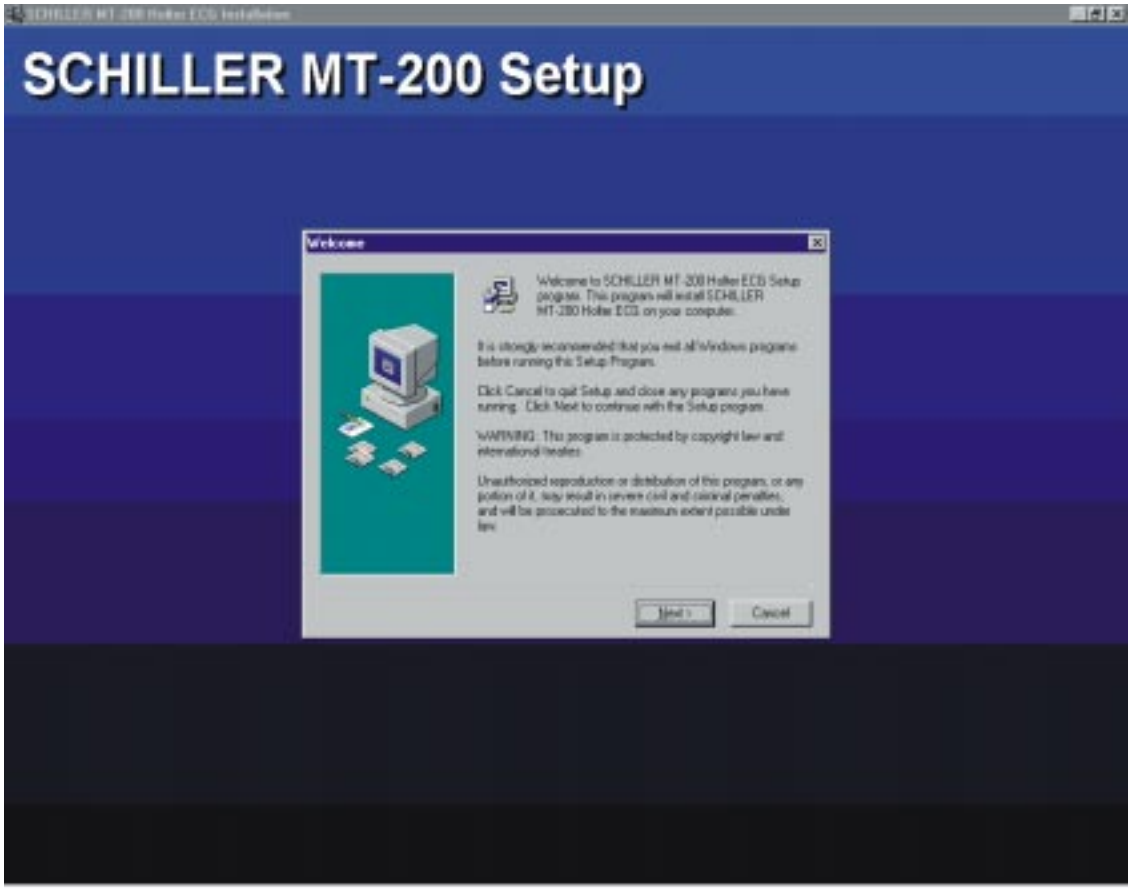
The diagram given is an example only. For the exact location of the parallel port connector on your computer refer to the handbook for your computer

Installing the Program

- **Start your computer under Windows 95 (or later).**
- **Insert the MT-200 CD into the CD drive of your computer.**
- **Access the CD drive and double click on the MT-200 `INSTALL.exe` file.**

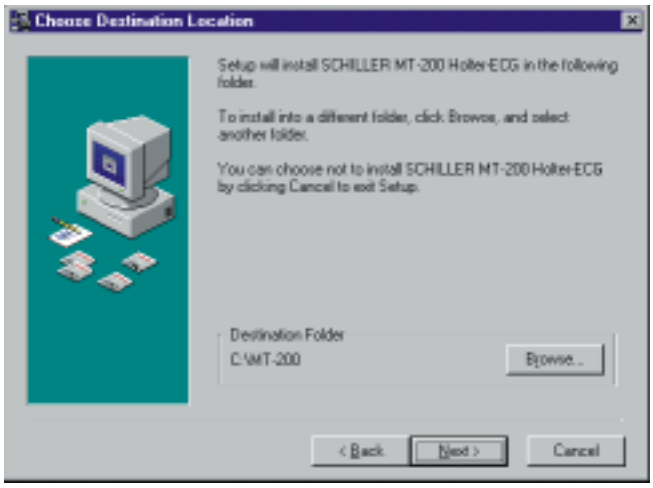
  or use the RUN option (in the START menu).
  - Go to the Start menu
  - Click on Run
  - Click on Browse
  - Select MT-200 (on CD drive)
  - Click on install

- **After a few moments the MT-200 installation program starts and the welcome screen is displayed:**

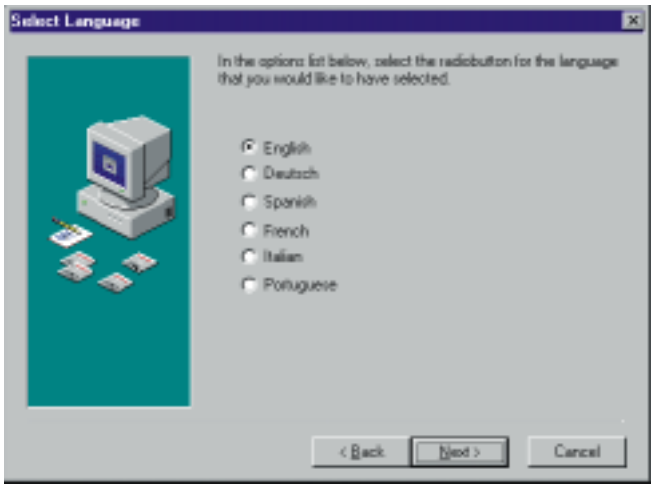


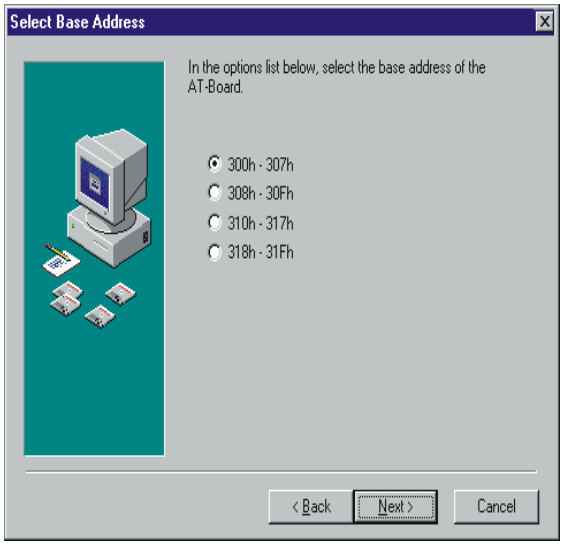
Installing the Program

Select where you wish to install the MT-200 program


Choose Destination Location
Setup will install SCHILLER MT-200 Holter-ECG in the following folder.
To install into a different folder, click Browse, and select another folder.
You can choose not to install SCHILLER MT-200 Holter-ECG by clicking Cancel to exit Setup.
Destination Folder
C:\MT-200
Browse...
< Back
Next >
Cancel

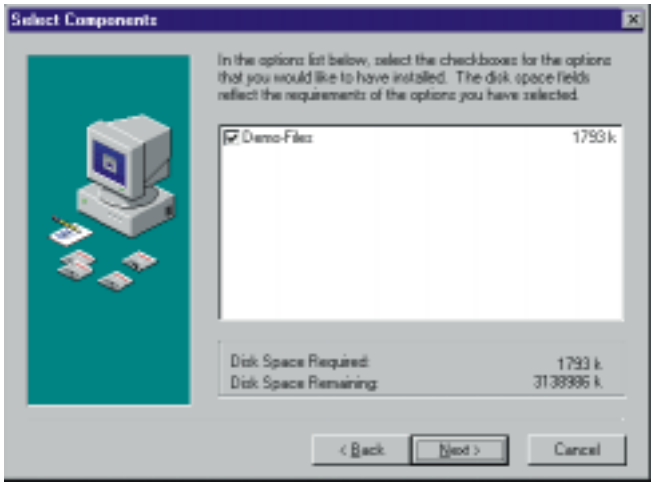
Select Language and Click OK

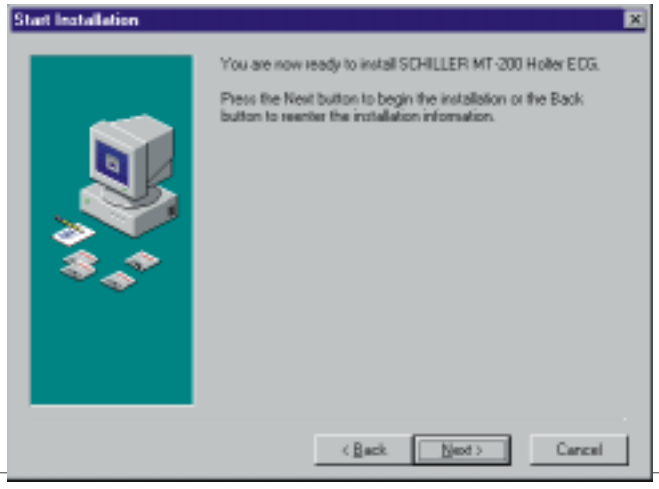



Select Base Address
In the options list below, select the base address of the AT-Board.
300h - 307h
308h - 30Fh
310h - 317h
318h - 31Fh
< Back
Next >
Cancel

Check the box for the address that has been set on the AT board (see previous pages) and click OK.

Install typical recordings for training purposes if required.

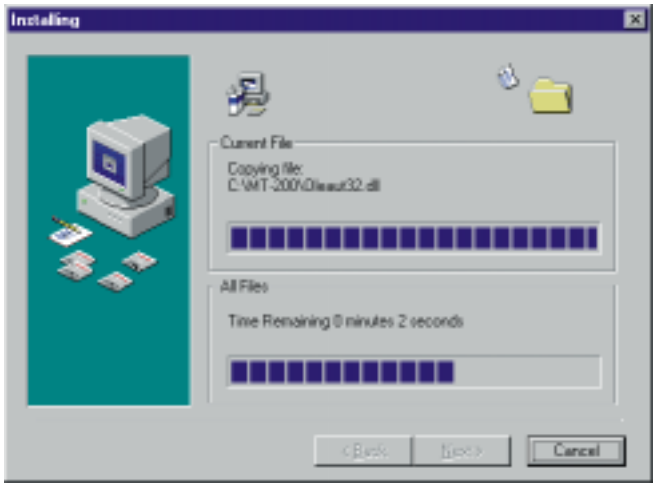

Select Components
In the options list below, select the checkboxes for the options that you would like to have installed. The disk space fields reflect the requirements of the options you have selected.
Demo-Files
1793 k
Disk Space Required:
1793 k
Disk Space Remaining:
3138896 k
< Back
Next >
Cancel


Start Installation
You are now ready to install SCHILLER MT-200 Holter ECG.
Press the Next button to begin the installation or the Back button to reenter the installation information.
< Back
Next >
Cancel

- **Click next to install.**

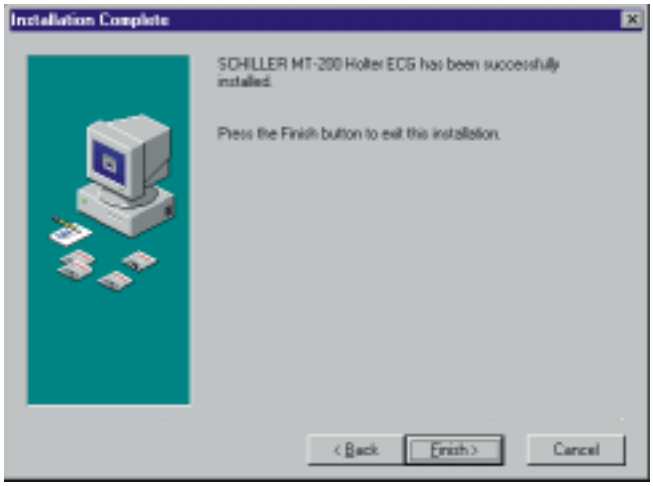
Installing the Program

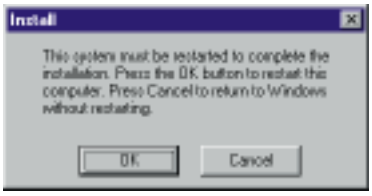
The program commences installation and creates a new folder on your hard disk called MT-200. The following screen is given detailing % completed.



- **Confirm installation by selecting Finish followed by OK to restart your computer.**

  If you wish to abort the installation select Cancel.


Installation Complete
SCHILLER MT-200 Holter ECG has been successfully installed.
Press the Finish button to exit this installation.
< Back
Finish >
Cancel


Install
This system must be restarted to complete the installation. Press the OK button to restart the computer. Press Cancel to return to Windows without restarting.
OK
Cancel

- **When the computer reopens, the MT-200 icon appears on the desktop.**

Select the MT-200 icon and double click with the mouse. Wait a few moments for the program to open.

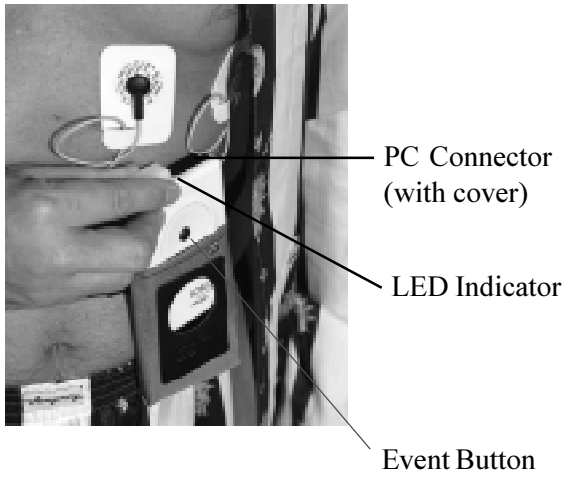
MT-100/MT-200

Holter Data Management and Analysis System

Annex A - MT-100 Standalone Use and Technical Specification

Commencing a Recording Without the MT-200 PC Program

Starting the Holter recording without the PC program is not recommended as the signal levels cannot be checked. Only do this when the PC program is inaccessible.



To start the Holter independently procede as follows:

- **Connect the Patient as described in Section 1**
- **Insert new batteries in the MT-100**
- **Switch the MT-100 on - press the event button. The LED lights and momentarily flashes off every 2.5 seconds.**
- **To start recording press the event button for approximately 4 seconds. The LED switches off and recording is indicated by the LED flashing momentarily every 2.5 seconds.**

Stopping the Recording

When the memory is full (approximately 24-25 hours), recording is stopped automatically - the LED stops blinking. The data remains in the memory until downloaded to the PC.

To stop the recording prematurely,

- **First remove the electrodes from the patient**
- Hold the event button pressed for approximately 4 seconds until the LED lights continuously then release the button.
- The LED extinguishes and the MT-100 is switched off.

Downloading to the PC

Download the recording data as detailed in Section 1

MT-100 Technical Data

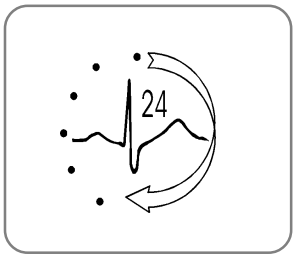
Technical data subject to change without notice.

Dimensions	110 x 70 x 19 mm; 4.3 x 2.7 x 0.7 ins	
Weight	140 grams; 0.3 lbs (with batteries)	
Battery	AA alkaline 1.5V (2 off)	
Battery Capacity	Working time 24 hours plus data transfer	
Power Consumption	120mW (recording) / 360mW (monitoring or downloading)	
Data Acquisition	Simultaneous sampling of two channels	
Environmental Conditions:	Temperature, Operating:	10^{O} to 40^{O}C
	Temperature, Storage:	-10^{O} to 50^{O} C
	Relative humidity:	25 to 95% (non condensing)
	Atmospheric pressure:	700 to 1060 hPa
ECG Amplifier:	Sampling frequency:	500 Hz
	Digital resolution:	12.5 µV
	Dynamic range:	±5.5 mVAC
	Max. electrode potential:	±300 mVDC
	Time constant:	3.2 s
	Frequency response:	0.05 to 150 Hz (-3 dB)
	Input impedance:	>2.5MOhms at 10Hz
	Common Mode rejection > 100dB	
Patient Input:	Fully floating and isolated, defibrillation protected.	
Safety Standard:	BF according to IEC and complying with the following	
	RL 93/42/EEC	
	EN 60601-1:1990	
	IEC 601-1	
	IEC 601-2-25:1993	
	pr EN 1441:1994	
EMC:	CISPR 11: 1985, EN 55011: 1992	
	IEC 801-2: 1991	
	IEC 801-3: 1984	
	IEC 801-4: 1988	
	IEC 801-5:	
Safety Class:	I according to IEC 601-1 (with internal power supply)	

Data subject to change without notice.

MT-100/MT-200

Holter Data Management and Analysis System



Annex B - Holter Options, Accessories and Disposables

Holter Options, Accessories and Disposables

Complete Systems

08238-0000	**MT-100 Recorder includes:** solid state **Holter recorder MT-100**, patient cable short, reusable carrying pouch, hook-up kit, short user manual.

Software / Hardware Options

08239-0000	**Template Matching software for MT-200 Holter software**
08259-0000	**Heart Rate Variability software**

Accessories 24-hour ECG Holter System

08241-0000	**Holter Hook-up Kit MT-100, including:** alcohol prep pads (2), surgical prop razor (1), patient diary (1), batteries AA, 1.5Volt Alkaline (2), pre-gelled electrodes (5), abrasive pad (1).
80188-0000	**Patient cable short**
80188-0001	**Patient cable long**
08240-0000	**Reusable carrying pouch**
80189-0000	**Opto transmission cable MT-100 to PC**